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The Efficacy of the Threshold Level of Public Debt :
A Panel VAR Approach

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Abstract

In this paper, we attempt to advance the discussions of Reinhart and Rogoff (2010) with rigorous econometric tools to explore the issue of the existence of non-linearity in public debt. We employ annual data sets of public debt-to-GDP ratio and per capita GDP growth rate which incorporate 20 advanced economies (1950 to 2008) and 14 emerging market economies (1970 to 2008). We adopt a panel VAR approach similar to the methodology used in Lee (2007). Our empirical results propose the followings, i) The causal relationship between the two variables discovered to be in one-way only, public debt causes the real per capita growth as our Granger Causality Test supports; ii) the threshold level of public debt contemporaneously exists at public debt-to-GDP ratio of 60% for the advanced economies and 90% for the emerging market economies; iii) The intertemporal dynamics of the per capita GDP and the public debt ratio display a detrimental divergence when exceeding the threshold level of 60% for advanced economies which implies that the Keynesian Effect turns out to be compromised by the Threshold Level Effect. The emerging market economies observe a convergence of the two variables exceeding their 90% threshold level which implies that the Keynesian Effect is strong enough to remain effective.

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Keywords: Public Debt; Panel VAR; Threshold Level of Public Debt; Keynesian Effect; Ricardian Equivalence; Austerity

Contents

Tables

1. Introduction

In recent years, the advanced economies of the Western Europe and the U.S. have suffered and continue to be suffering until these days from what is believed to be unprecedented in that the core of the economic hardship was the public debt[1]. From the default crisis of the U.S. economy in 2010 to current economic issues around EU member countries, public debt had played a central role. These difficulties of advanced economies have caught special attentions of many economists due to the fact that it was conventional to consider public debt problems as emerging markets' phenomenon until now.

Despite the conventional wisdom that the advanced economies are somewhat disciplined around public debt issues, the facts tell us otherwise. For more than three decades from 1970s, some of the countries of the advanced economies, especially the European countries, were piling up their public debts until the burst of the economic meltdown in 2008. By the year 2008, the average debt-to-GDP ratio of Eurozone countries soared to 70% which is 10% higher compared to the early 1990s. The situation turned out to be much severe especially leading up to the year 2007, where the ratios had increased by 10 to 60%[2] of GDP. In the case of the U.S. economy, the debt ratio increased by 38.4% of GDP from 1970 to 2008. The age-old problem of the public debt in Japan is needless to be mentioned. These dramatic increases of the public debt ratios is perceived to be caused, in large part, by the reluctance of the governments. Alesina and Perotti (1996) supports the view. Their study claims that the stabilizations of the public debts rely heavily on the cuts in government spending, not the adjustments in tax rates. The role of government in stabilizing public debts is considered to be essential.

Figures 1, 2 and 3 demonstrates visual representations for easier understandings of the trend in public debt-to-GDP ratios across some of the advanced economies from 1970 to 2008. As it is clear in the figures, the advanced economies experienced unprecedented levels of public debts during the years, the most severe one being Japan as expected.

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1 "public debt" refers to the gross central government debt.

2 See Eichengreen et. al (2011) for details.

Figure 1. U.S. Public Debt-to-GDP ratio (1970-2008)

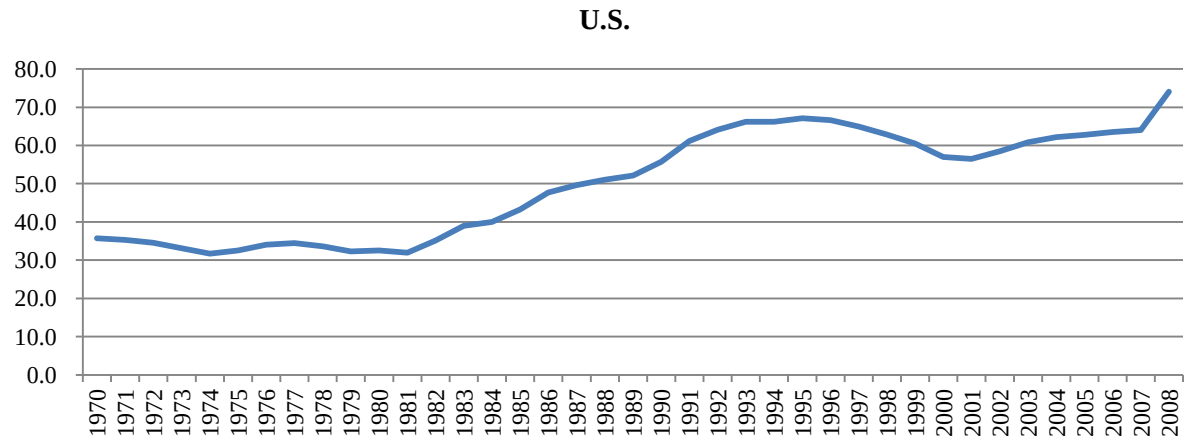


Figure 2. Japanese Public Debt-to-GDP ratio (1970-2008)

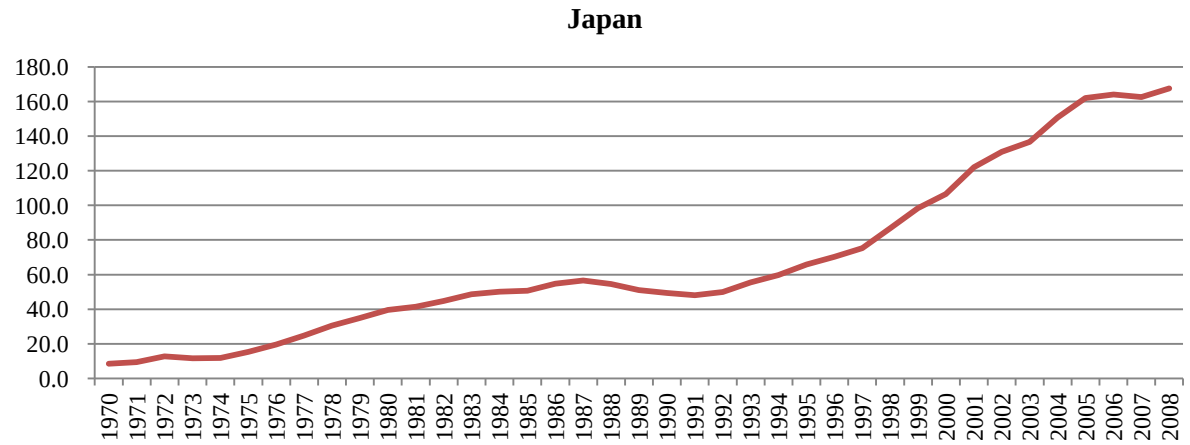
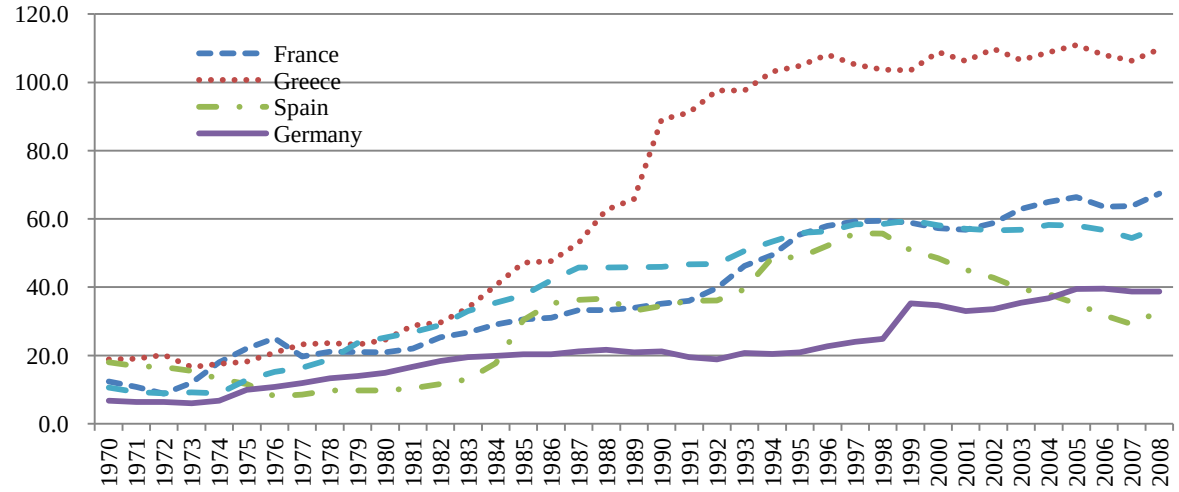


Figure 3. Public Debt-to-GDP ratio of major EU member economies (1970-2008)



In the midst of the economic difficulties of the advanced economies, there had been many empirical studies which analyzed the general economic implications of public debts. Among many, Reinhart and Rogoff (2010) claims a rather interesting argument of the behavior public debt. By implementing various statistical tools on their broad range of data sets of OECD member countries, it concludes that there exists a threshold level of public debt-to-GDP ratio across all of the sample countries. It argues that if the ratio exceeds the threshold level, it directly affects the growth rate and that the tipping-point is at public debt-to-GDP ratio of 90%. This argument of possible non-linearity between the public debt and the growth recently have caught a lot of eyes in the field of fiscal policy because the existence of the threshold level enables the further discussions of other economic implications of fiscal policy, such as the existence and efficacy of *fiscal rules* and the existence of a causal relationship between public debt and the growth.

For example, if the threshold level of public debt indeed exists, EU's Stability and Growth Pact (SGP) implemented by the Maastricht Treaty of 1992 can gain some support as being a valid fiscal rule which intends to manage the sustainable public debt levels across its member countries. The possible support for the SGP is especially conspicuous when many studies had been done doubting its efficacy. For example, Gali and Perotti (2003) argues that SGP makes it difficult for the governments of the EMU to stabilize the fiscal states of their countries and to implement proper measures of fiscal policy during difficult times.

The non-linearity of public debt might also provoke discussions on the traditional *Keynesian Effect* of government spending on economy's output. The traditional Keynesian belief is that the increase in government spending, and hence increase in public debt, increases the aggregate demand which consequently increases the overall output of the economy along with increase in interest rate. However, in case if the proposition of the existence of the threshold level of public debt holds true, the *Keynesian effect* is equivalent to work in opposite direction. According to Reinhart and Rogoff (2010), public debt-to-GDP ratio higher than 90%, in fact, significantly decreases the median growth rate by more than 1%.

The *Ricardian Equivalence Theorem* where the public debt levels do not affect the output both in

the long-run and in the short-run, is also not the case if the public debt indeed demises the growth after exceeding the proposed threshold level.

Although Reinhart and Rogoff (2010) had set the corner stone in discussing the importance of the non-linearity of public debt, it has used limited methods to adequately prove the existence of the tipping point. There had been some criticisms on the methodology it has employed. For example, Irons and Bivens (2010) claims that "... the GITD “90% threshold” for gross government debt should not be used as a guide for U.S. fiscal policy, as both the theory and the data in the paper rest on exceptionally shaky foundations."[3]

The work of Irons and Bivens (2010) does offer some notable critiques on GITD, but it also is lacking rigorous econometric methodology to prove that such a threshold level of public debt does *not* exist. Considering the importance of the topic, both the works of Irons and Bivens (2010) and Reinhart and Rogoff (2010) lack correspondingly rigorous means of analysis.

In light of this, many studies had been done in exploring what had been claimed by GITD. The most notable one among many, is Woo and Kumar (2010). The study attempts to enhance the analysis of GITD by employing econometric tools like pooled OLS, Fixed effects panel regression and Between Estimator with panel data of 38 advanced and emerging market economies from 1970 to 2008. Controlling for some useful variables such as inflation rate, government size and trade openness, it concludes that the negative correlation between public debt and growth does exist and it also confirms that the nonlinearity of public debt indeed exists. However, its method of analysis has its limits in explaining the possibility of the reverse causality (i.e. growth *causes* public debt)[4].

Canner and Grennes (2010) employs larger data set of 99 developing and developed economies and also confirms that the threshold level of public debt exists but claims that the tipping point is at public debt-to-GDP ratio of 77%. The research has used Threshold Least Square Regression to obtain the results. They propose that each additional percentage increase in public debt costs 0.017 percentage

[3] "GITD" refers to the title of Reinhart and Rogoff (2010), "Growth In a Time of Debt". We will refer to Reinhart and Rogoff (2010) by this abbreviation from now on, GITD, for simplicity.

[4] In order to control for this possibility, Woo and Kumar (2010) has regressed current public debt on growth of the next five consecutive years. But the structure of the regression itself is implicitly assuming only one way of causality, public debt to growth. Therefore it has its limits in proving that the reverse causality does *not* exist.

points of annual real growth. By employing the Least Square approach, the study focuses only on the long-term relationship of public debt and growth.

Taylor et. al (2012) employs the data set of U.S. economy and claims a rather different relationship of the two variables. They have approached the problem with a VAR method and concludes that the relationship is a positive one.

In this paper, we attempt to advance the discussions of Reinhart and Rogoff (2010) with rigorous and distinctive econometric tools to explore the issue of the existence of non-linearity in public debt. We employ the same data sets as the Reinhart and Rogoff (2010), which incorporates 20 advanced economies (AE) and 14 emerging market economies (EME)[5], ranging from 1955 to 2008 for AE and 1970 to 2008 for EME. We adopt a panel VAR approach with Fixed Effects Generalized Least Square Regression, similar to the methodology used in Lee (2007).

One of the advantages of adopting this methodology, in addition to the advantages of ordinary VAR approach, is that we can estimate more accurate effects of public debt on real growth rate by taking into account the unobserved effects of each economy with country specific dummy variables and the business cycle effects with year specific dummy variables. The model also takes the advantages of the GLS regression, which allows the error terms to be heteroscedastic by taking into account the heterogeneity of the sample countries which were chosen from a wide range of the regions throughout the world.

The main contribution of this paper comes from the fact that by employing the proper controls for the specifications, the existence of the threshold level effect of public debt and the dynamics of the public debt-real growth relationship are discovered in detail. Furthermore, by organizing another specifications, we are able to estimate an accurate effect of the threshold level of public debt.

The remainder of this paper consists of the following. In section 2, we explain the specifications of the VAR model we have used and specify some of the econometric issues immanent within the

[5] Some of the countries of Emerging Market Economies have been omitted in our study due to discontinuous data. The omitted countries are Costa Rica, Ecuador, El Salvador, Ghana, Kenya, Korea, Nigeria, Peru, Singapore, South Africa, Sri Lanka, Turkey. We have tried to use as many countries as possible but in order to implement a balanced panel analysis, the above countries inevitably had to be omitted. Reinhart and Rogoff (2010) however, was not constrained by such constraint because they approached the problem with only basic statistical averages.

specifications. Section 3 lays out the results of the regressions and its implications. In section 4, we conclude our analysis.

2. Model Specifications and the Data

2.1 The basic characteristics of the model

The most of the previous researches on the related topic had mainly focused on employing the Least Square approach, if not only preliminary methods of statistical analysis. The main focus of GITD had been solely on whether the threshold level of public debt exists or not. It lacked conventional econometric tools and therefore its result was too weak to be accepted as a consensus. Their study only incorporated statistical averages which had neglected many possible statistical errors and biases of their wide range of data sets.

Woo and Kumar (2010) also have used a least square approach in which, it can only be perceived as long-run dynamics of the two variables. In addition, their study has its strength in analyzing the overall relationship of the growth and public debt, but it has limits in a sense that it assumed that the public debt affects the growth but not in the opposite direction. Therefore it left a question mark on the possible reverse causality.

With proper specifications, this study intends to enhance the discussion by providing more of an in-depth analysis on the topic with rigorous econometric tools. Our panel VAR model can be advantageous in several ways : i) By adopting a panel VAR model (with two endogenous variables, public debt and per capita GDP growth rate), the results can provide a distinctive view on the causalities between the two variables by assuming that neither variable is exogenous; ii) The model controls the business cycle effects by employing year-specific dummy variables and also controls unobserved fixed effects by employing country-specific dummy variables which is conventionally not considered under the ordinary VAR framework; iii) The model also controls the initial condition of the economy by adding a variable that represents 5-year growth rates of the countries[6]; iv) By organizing

[6] This variable is conventionally used in growth regressions in order to consider the overall stage of the economy. It is justified by the Solow's Growth Model where the main idea of the model is that different economies are consisted of

an additional specifications, we are able to carry on further analysis on what happens after the economy steps over the threshold level of public debt (if the threshold level exists), which also enables us to compare the intertemporal magnitudes of the impacts of different threshold levels.

2.2 The baseline specifications

As the main objective of this paper is to estimate the public debt effect on growth, the main specification in interest is the following :

$$Y_{it} = \sum_{j=1}^{k} \beta_{1j} Y_{it-j} + \sum_{j=1}^{k} \beta_{2j} D_{it-j} + \theta(Y_{it} - Y_{it-5}) + \gamma_1 D60_{it} + \gamma_2 D90_{it} + \gamma_3 POL_{it} + \delta_i + \mu_t + u_{it}$$[7]

Eq. (1)

Where,
$Y_{it-j} =$ The real per capita GDP growth rate of country *i* at time *t - j*, measured in 1990 Geary-Khamis International Dollars
$D_{it-j} =$ The total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t - j*;
$(Y_{it} - Y_{it-5}) =$Logarithm of the 5-year real growth rate of country *i* at time *t*;
$D60_{it} =$ A dummy variable that takes the value 1 if the public debt-to-GDP ratio of country *i* at time *t* is over 60% and takes value 0 otherwise;
$D90_{it} =$ A dummy variable that takes the value 1 if the public debt-to-GDP ratio of country *i* at time *t* is over 90% and takes value 0 otherwise;
$POL_{it} =$ Political status of country *i* at time *t* measured in scores from 0 to 10 based on the soundness of the democracy;
$\delta_i =$ Country *i* - specific intercept representing the unobserved fixed effects;
$\mu_t =$ The year *t* - specific intercept;
$u_{it} =$ White noise error term.

The specification for the public debt regression is consisted of the same independent variables as the growth regression, consistent with the conventional VAR framework, as the following :

different labor-to-capital ratio. By controlling the five-year growth, we treat the impact of one-percentage growth on the economy in one country in a certain growth stage differently with one-percentage growth in another country that is in a different growth stage.

[7] This specification is applied to both AE and EME regressions with only differences being the sample years *t* and the number of countries *i*.

$$D_{it} = \sum_{j=1}^{k} \beta'_{1j} Y_{it-j} + \sum_{j=1}^{k} \beta'_{2j} D_{it-j} + \theta'(Y_{it} - Y_{it-5}) + \gamma'_1 D60_{it} + \gamma'_2 D90_{it} + \gamma'_3 POL_{it} + \delta'_i + \mu'_t + u'_{it}$$ [8]

Eq. (2)

A few remarks need to be mentioned on the specifications Eq.(1) and Eq.(2). The dummy variables of $D60_{it}$ and $D90_{it}$ are chosen out of many other possible options of threshold levels (i.e. 40%, 50%, 100% etc.,) because for the following reasons. First, if all of the threshold levels were chosen and included in the regression, that would cause a severe multicollinearity problem. Second, our study attempts to enhance the previous existing literatures and hence, it seems to be logical to adopt already-existing possible threshold levels and to comparatively analyze and investigate whether the levels are meaningful or not. The threshold level of 60% is the debt limit of EMU countries imposed by the Stability and Growth Pact (SGP) of the Maastricht Treaty. The threshold level of 90% is proposed by the GITD which started up the debate on the nonlinearity of the public debt. Comparatively studying the two threshold levels in depth enables us to make references to the real-world phenomena where just searching for the absolute threshold level impractically is relatively less so.

Another interesting aspect of the specifications is that it incorporates the political variable POL_{it}. Unlike other variables in economics, addressing the political states and its decision-making process is inevitable in approaching the public debt issue. The public debts move correspondingly with the government spending which in turn, are directly affected by the political decision-making system of the economy. Alesina and Perotti (1996) emphasizes the conditions required for the debt stabilizations as the following.

"...the two critical areas of reform are: first, more transparency; second, a strengthening of the roles of the executive branch...".

For this reason, we have acquired what can be considered as a proxy of the government

[8] This specification is applied to both AE and EME regressions with only differences being the sample years *t* and the number of countries *i*.

transparency, the soundness-of-the-democracy score[9]. The logic behind employing this data set, is that as a country becomes more democratic, the decision-making process is forced to be more transparent compared to a less developed democratic economy in which case is often ruled by a dictator or by military forces. Since the spectrum of the political states of our sample countries are broad across advanced economies and emerging market economies, we expected to see relatively clear effects of the political variable on public debt and on the growth rates of the economies.

As briefly mentioned in the previous section, the model also controls the initial condition of the economy by considering $(Y_{it} - Y_{it-5})$ in the regression. This initial condition control is conventionally used in growth regressions in order to control the different economic levels of the countries. It is based on the Solow Growth Model which argues that as an economy climbs up the ladder of developments, the composition of the labor-capital ratio changes, and therefore the corresponding marginal product of capital changes. If the differences in the marginal products of capital across economies are not considered, it is equivalent to treating one-percentage growth of a less developed economy as the same as one-percentage growth in more developed economy, which cause biased estimates. The choice of a five-year control of initial condition is conventionally used in many growth-related literatures which seems to be a reasonable period for an economy to confront a different marginal product of capital (or capital-labor ratio) and therefore we adopt this length for the initial control.

Lastly, δ_i and μ_t each control for unobserved fixed effects and year- specific (business cycle) effects of the sample countries. The unobserved fixed effects control the different overall characteristics of the sample countries such as regions, religions, languages, cultures, demographics, and so on. The year- specific effects variable μ_t has two important roles which are, controlling economic shocks in a given year and a detrending effect for possible non-stationarity problem.

[9] Details of the data set will be addressed in the later subsection.

2.3 Econometric Issues

The two regressions Eq. (1) and Eq. (2) jointly form a panel VAR model but not a text-book case in several ways. First, the model incorporates control variables that are specified in the previous subsection which is not conventionally used in a typical VAR approach. Secondly, we perform GLS Fixed Effects regressions with Eq. (1) and Eq. (2) in estimating the coefficients, which also distinguishes our model from an ordinary VAR approach which typically employs OLS regressions. Because of such exclusivity, our specifications incorporate several econometric issues that needs to be addressed.

First, the most important factor of consideration, prior to estimating a VAR model, is to choose the lag structure. Although, a lag length of two is conventionally employed in analyzing panel data sets, we have derived the *Akaike Information Criterion* (AIC) in order to be more corroborate. In our model, the process of choosing the maximum lag length in consideration needed to be more thoughtful than the text-book case[10]. Both Eq. (1) and Eq. (2) contain the independent variable of($Y_{it} - Y_{it-5}$), and therefore, if the lag length higher than 2 is chosen, one can easily see that there will be a severe multicollinearity problem. For this reason, we have considered the maximum lag length of 2 and derived the AIC for both the lag 1 model and the lag 2 model. The result of the AIC then has preferred the optimal lag length of 2 for both AE and EME cases.

In deriving the AIC, we have employed the following method :

$$AIC = T\ ln|\Sigma| + 2N$$

Eq. (3)

where,
T = Number of usable observations
N =Total number of parameters estimated in all equations
$|\boldsymbol{\Sigma}|$ = Determinant of the robust variance-covariance matrix of the residuals.

The likelihood ratio test is also widely used in VAR literatures to derive AIC, but the likelihood ratio test is suitable only for small sized sample data. Therefore, the methodology of Eq. (3) seems to

[10] Maximum lag length of 4 is conventionally tested for panel data analysis in deriving the AIC.

be the optimal choice in our case.

In facing panel data sets, the method of estimation becomes an essential part of analysis, namely, the choice between Random Effects (RE) and Fixed Effects (FE) estimations. This issue ties in our case, with controlling the country- specific unobserved effects. The RE estimation method is equivalent to assuming that all of the unobserved effects are not correlated with explanatory variables (which means the overall differences in characteristics across the cross-sections are randomly distributed), where FE estimation assumes that there exists different characteristics for different sample cross-sections (in our case, different countries)[11]. As our sample countries extensively differ in many ways (i.e. region, culture, productivity, etc.,), it seems reasonable to control the unobserved fixed effects which makes our model FE estimations[12].

A few comments about the error terms of the model also need to be mentioned. Working with the ordinary assumption of the error term being *i.i.d.* seems to be too strict considering the broad range of the countries this study incorporates. Therefore, we employ GLS regression with cluster-robust standard errors to take account the heterogeneity of the sample countries[13]. Although the heterogeneity of the sample countries are controlled to some degree by implementing FE estimation, the FE estimation has no role in dealing with intra-cluster correlation of errors. The cluster-robust standard errors relaxes the assumption of *i.i.d.* of error terms and thereby allows arbitrary correlation of the error terms within each cross sections. The absence of the cluster-robust standard errors leads to under-estimation of standard errors and therefore to over-estimate the significance of the coefficients[14].

Lastly, the problem of the non-stationarity of public debt-to-GDP ratio requires some justifications. The both of the data sets of real per capita growth rate and public debt-to-GDP ratio are tested for the non-stationarity by *augmented Dickey-Fuller unit root test (ADF)*. The result shows that the data set of public debt-to-GDP ratio likely bears unit root problem in it. Despite the test result, there are a few

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[11] More precisely, FE : $\mathrm{Corr}(\delta_i, x_{it}) \neq 0$, RE : $\mathrm{Corr}(\delta_i, x_{it}) = 0$.

[12] Although, both FE and RE estimators were performed, we only report the FE estimator results. For the results of RE estimator, refer to the Appendix section.

[13] Also known as Huber-White-Sandwich Estimator.

[14] For more details, refer to Cameron and Miller (2010)

justifications on the data set as being a reasonable one to use in our framework. First, according to Sims et. al (1990)[15], the main purpose of analysis by VAR framework is to discover the dynamics of the variables in interest, not to estimate the precise coefficients of the variables and therefore non-stationarity problem is not as serious as it is in other methods of estimation. This claim exactly matches one of our purposes of the study which is to discover the dynamics between public debt and growth. Secondly, by employing the year- specific dummy variables, we are able to offset the non-stationarity in public debt-to-GDP ratios to some extent. The most important aspect of this issue is that public debt-to-GDP ratio can be considered as being a processed data since it is a ratio, and therefore has no obvious fundamental reasons to be non-stationary.

Furthermore, our public debt-to-GDP ratio data set takes the form of the panel data and thus, time series issues like the non-stationarity problem comes of a less important technical topic. Also, it is known that in panel data settings, the degree of the non-stationarity of the data decreases exponentially as the number of cross-sections approach infinity. Since our number of cross-sections, *N,* are relatively large compared to the time-series, *T,* the unit root problem in this case can be considered to be settled.

[15] Sims, Stock and Watson (1990)

2.4 The Data

As this study attempts to enhance the GITD, the data set being used is very similar to the one used for the GITD. First, we categorize the data set into two groups, Advanced economies (AE) and Emerging market economies (EME). AE is consisted of 20 countries being Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States, where EME is consisted of 14 countries being Argentina, Bolivia, Brazil, Chile, Columbia, Egypt, India, Indonesia, Malaysia, Mexico, Philippines, Thailand and Uruguay.

The annual data sets of gross central government debt ratio is obtained from Prof. C.M. Reinhart[16] which is measured in percentages of GDP. The longest data set spans as far back as 1800's but in this study, we only employ data sets from 1955 to 2008 for AE and from 1970 to 2008 for EME in order to implement balanced panel regressions[17].

The annual data set of the real per capita GDP is strictly from the same source and the same number of sample years for both AE and EME as the public debt data set[18]. It is measured in real term, Geary-Khamis 1990 international dollars and we have derived the growth rate from it. All of the real growth observations are inserted in percentage points into the regressions for the compatibility of digits with the public debt-to-GDP ratio.

The political variable is rather difficult to obtain than any other variables in the model in that there does not exist a credible methodology in distinguishing or enumerating the decision-making process (or the political system) of a country. Therefore, the only viable option would be to set a certain political system(i.e. Democracy) and evaluate each country with a hierarchical score system which makes it compatible regressing it with other enumerated variables, real growth rate and public debt-to-GDP ratio. The polity4 score created by the University of Maryland incorporates a score system that

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16 Available on the webpage of Prof. C.M. Reinhart at http://www.carmenreinhart.com/data/browse-by-topic/

17 Unbalanced panel regression is also performed but for the reason that there are less factors that can be controlled for, balanced panel regression seems to be suitable for rigorous analyses and interpretations.

18 Although we have obtained the data set from the webpage of Prof. C.M. Reinhart, but the origination of the GDP data set is from Angus Maddison. The data is updated and maintained by University of Groningen's Total Economy Database (TED). The author is grateful of the extraordinary data set created by Angus Maddison who passed away in 2010.

ranges from 0 to 10 depending on the soundness of the country's democracy where 0 being no institutionalized democracy (autocracy, dictatorship etc.,) and 10 being a fully institutionalized democratic system[19]. The polity4 score is a panel data set that consists of the scores for 168 countries spanning as far back as 1800's. In dealing with the difficulties of choosing a political variable that has some relativity to the decision making process of government spending, the polity4 score is relatively suitable for our model.

It should be noted that the countries and their groupings as AE or EME strictly follow the GITD with only exception being the omission of Costa Rica, Ecuador, El Salvador, Ghana, Kenya, Korea, Nigeria, Peru, Singapore, South Africa, Sri Lanka, Turkey from the EME group due to the discontinuous data set of the gross central government debt-to-GDP ratios. The omission of the above countries are significant loss of the observation number, but not a critical one since the sizes of the economies have been relatively small throughout the sample years.

Overall, AE consists of 20 countries with 53 years of data which makes up a total of 1060 observations where EME consists of 14 countries with 38 years of data which adds up to 532 total observations.

2.5 Additional Specifications

As mentioned in the introduction section, one of the main goals of this paper is to examine the public debt effect on growth. Even though the panel VAR model specified in the previous subsection is able to offer effective analysis on public debt-growth dynamics, it has its limits in explaining the dynamics of the *threshold level effects* of public debt on growth. More intuitively, what happens after an economy reaches the public debt-to-GDP ratio of 60% or 90%? To what extent, the threshold level effects the future growth and public debt?

In order to answer these questions, we have organized another set of specifications. The only change made from our baseline system of equations is the addition of interaction variables that

[19] For more details on the scoring system or the origination of the data set, refer to http://www.systemicpeace.org/polity/polity4.htm

reflects the situation when the public debt of an economy passes through the proposed threshold levels. The specification for the growth regression then becomes :

$$Y_{it} = \sum_{j=1}^{k} \beta_{1j} Y_{it-j} + \sum_{j}^{k} \beta_{2j} D_{it-j} + \sum_{j=1}^{k} \beta_{3j} Y_{it-j} \cdot D(x)_{it-j} + \sum_{j=1}^{k} \beta_{4j} D_{it-j} \cdot D(x)_{it-j}$$
$$+\theta(Y_{it} - Y_{it-5}) + \gamma_3 POL_{it} + \delta_i + \mu_t + u_{it}$$

Eq. (4)

and similarly, the public debt regression becomes :

$$D_{it} = \sum_{j=1}^{k} \beta'_{1j} Y_{it-j} + \sum_{j}^{k} \beta'_{2j} D_{it-j} + \sum_{j=1}^{k} \beta'_{3j} Y_{it-j} \cdot D(x)_{it-j} + \sum_{j=1}^{k} \beta'_{4j} D_{it-j} \cdot D(x)_{it-j}$$
$$+\theta'(Y_{it} - Y_{it-5}) + \gamma'_3 POL_{it} + \delta'_i + \mu'_t + u'_{it}$$

Eq. (5)

Where $D(x)_{it}$ represents the threshold level dummy variables, *D60* and *D90*.

The interaction terms in Eq. (4) and Eq. (5) capture the dynamics of the threshold level effect of public debt on the endogenous variables. It needs to be emphasized that Eq. (4) and Eq. (5) are organized in an attempt to focus on the *dynamics* or *intertemporal effect* of the threshold level effect of public debt rather than the statistical significances of the coefficients. Estimating the coefficients β_{3j} and β_{4j} of the system of equations (4) and (5) then, provides us an in-depth analysis on what the intertemporal and additional impact would be after an economy reaches threshold levels of 60% and 90%.

3. Empirical Results

3.1 The results of the baseline regressions

We now look at the results of the estimations of Eq. (1),(2),(4) and (5). Columns (3) and (4) of Table 1, and Columns (3) and (4) of Table 2 report the estimated coefficients of the equations stated above, respectively[20].

In order to prevent the possible rise of the multicollinearity problem when estimating the full sets of year- and country-specific dummy variables, we have omitted the dummy variables of the first five years among the year-specific dummy variables set, and omitted the country-specific dummy variables of U.S. among the Advanced Economies and Venezuela among the Emerging Market Economies for the same reason. The logic behind in choosing which country-specific dummy variable to omit is that the size of the U.S. economy is overwhelmingly large compared to other countries, and thus, omitting the U.S. country-specific dummy variable provides the model more detailed control compared to the case where we omit other country's country-specific dummy variable[21].

Reporting the main results of the estimation, Columns (3) and (4) of Table 1 and 2 displays the results of the estimation of the regression Eq. (1) and Eq. (2) for the AE and the EME, respectively. We first analyze the results of the Advanced Economies. It is evident in Column (3) of Table 1, that 1% increase in the public debt has a positive effect of 0.0574% on the real per capita GDP growth in lag 1 at 1% significance level and a negative effect of 0.0460% in lag 2 at 5% significance level.

Column (4) of Table 1 reports the estimated coefficients of the public debt regression. It provides us an evidence that the effects of the both of the lags of the real per capita GDP growth rates on public debt have no statistical significance, even at 10% significance level.

The above results provide a strong support for the existence of a one-way causality between public debt and growth. Despite the fact that the effects of public debt on growth is mismatched (with the effects being positive in lag 1 and negative in lag 2), it is estimated to be statistically significant that

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[20] Since we have adopted the Fixed Effects estimator for the reasons stated in the previous section, we only analyze the estimated coefficients of the corresponding estimator which is reported in Columns (3) and (4) of Table 1 and 2.

[21] More intuitively, controlling for relatively homogeneous economies provides stronger control for the whole system, compared to controlling for one large economy with many similar sized economies. In addition, the estimated results of the year- and country-specific dummy variables are included in the Appendix.

the public debt affects the growth but not vise versa.

Slightly different results are apparent in the model for the EME group in Columns (3) and (4) of Table 2, where the effect of public debt on growth being positive in both lags. That is, last year's 1% increase in public debt increases the per capita real GDP growth of this year by 0.0186% at 10% significance level, and also increases per capita real GDP growth rate of next year by 0.0180% at 1% significance level. In addition, the effect of the real per capita GDP growth on public debt is only statistically significant in lag 2 case among the EME.

As clarifying the causal relationship of the two variables is the starting-point to address the threshold effect of public debt on growth, the above results provide the stepping-stone for us to proceed to further analyses by confirming that the effects of the public debt on growth rate is relatively stronger and significant compared to the effects of the growth rate on the public debt[22]. Solidifying the above results, our Granger Causality test does not reject the hypothesis that the public debt does not Granger-cause the real per capita growth rate[23].

Since the causality problem is resolved to some extent, we now go on to look at the existence of the contemporaneous threshold level effect of public debt. First, in case of the AE, Column (3) of Table 1 suggests that the effect of dividing the public debt levels by 60% is statistically significant at 5%. In other words, the results of the estimation proposes that the contemporaneous threshold level effect of 60% of public debt indeed existed during the sample period among the AE. According to our model, current public debts higher than 60% of GDP demises the current real per capita growth rates of the AE by 0.349% which can be read from the coefficient of the explanatory variable $D60_{it}$ in Column (3) Table 1.

In the EME case, in Column (3) of Table 2, the threshold level of 90% is estimated to be statistically significant at 5% which can be read from the estimated coefficient of $D90_{it}$. The public debt levels of the EME higher than 90% demises its real per capita growths by -1.548%, and the

[22] In case of the regressions with only lag 1 explanatory variables, the one-way causality is more strongly proven to be present. For the results refer to the full listings of the results in the Appendix.

[23] Despite the fact that the Granger Causality test has its limits in our model due to the possible non-linearity, it nonetheless displaces a strong results supporting our hypothesis therefore possibly be a support to some extent. For methodology used in performing the test, refer to the Appendix.

threshold level of 60% in this case, appears to be insignificant.

With the results stated above, we can now refer to the existence issue of the threshold level of public debt proposed by GITD. According to our estimation, it in fact, does seem to be meaningful to discuss about the threshold level effect of public debt on growth but with the levels being different between the AE at 60%, and the EME a90%. That is, the results displays the possibility that the viable threshold levels can be different depending on the overall state of the economy. As oppose to our results, the GITD have argued that the threshold level of 90% is apparent globally regardless of the countries' categorization.

In the AE case where the threshold level of public debt is estimated to be 60%, our model is able to provide some support for the Stability and Growth Pact (SGP) of the EMU. Despite many criticisms on the SGP[24], our model suggests that fiscal rules based on ceiling the public debt-to-GDP ratio to certain level is effective, at least in terms of securing the country's growth rates. On the contrary, the 90% threshold level for the EME is consistent with the propositions of the GITD.

The difference in estimated threshold levels of the AE and the EME is one of the most interesting turn-outs of our model. Although, the EME appears to face a higher threshold level, they suffer in a significantly greater magnitude compared to the AE once the public debt exceeds the threshold level of 90% with its effect on growth being -1.548% (on the contrary, the threshold level effect is -0.349% of growth in case of AE).

Although, the main objectives of this study do not include the theoretical reasoning behind the different threshold levels and their consequences the AE and the EME face, it is possible that relatively higher cost of issuing government bonds for EME compared to the AE, and therefore higher opportunity costs of their public debts, had played a significant role in damaging the growth rates after exceeding the threshold level of public debt. In addressing the differences in the threshold levels between the two groups, it appears that the most probable cause of the resulting higher threshold level of EME, is that they might have had relatively higher growth rates during the sample years compared

[24] The most of which argues that limiting the public debt-to-GDP ratio limits the governments to implement counter-cyclical fiscal policies, which significantly demises its abilities in coping with economic difficulties.

to the AE, which consequently have provided them with higher capabilities to sustain higher public debt ratios without damaging their growth rates.

Furthermore, the different effects of the public debt to growth rates across the two groups bare an important economic implication. The positive lag 1 effect of public debt to growth rate in AE case implies that the countries' *Keynesian Effect* is present where it fades away in the next period. In the EME case however, the *Keynesian Effect* continues to be effective longer than the AE. The longer, and therefore stronger *Keynesian Effect* among the EME plays a critical role in making the argument of this paper[25].

Next, we interpret the results of the public debt regressions (Columns (4) of Table 1 and 2). The effects of the lagged fiscal variables (D_{it-j}) on the current public debt level (D_{it}) are different across the lag lengths of 1 and 2 with lag 1 effect being positive and lag 2 being negative for both groups. The effects of the current threshold levels $D60_{it}$ and $D90_{it}$ on the current public debt however, are relatively clear. In the AE case (Column (4), Table 1), the threshold level of 60%, $D60_{it}$, has a positive effect of 1.736% on the current public debt level, and the threshold level of 90%, $D90_{it}$, also has a positive effect of 1.068% on the dependent variable both of which are statistically significant at 1% and 10% respectively. On the contrary, the threshold level estimations of the EME (Column (4), Table 2) shows rather dramatic results. The current 60% level, $D60_{it}$, has a positive effect of 17.37% with the 90% level, $D90_{it}$, also having a positive effect of 28.66%, both statistically significant at 1% level. The dramatic difference in threshold level effect on public debt infers that the EME has been more aggressive in increasing the public debts in excess of 60% or 90% level where the AE has been much more cautious in increasing their public debts, had it reached the 60% or 90% mark.

Regardless of the magnitudes of the increase in public debt after reaching the specified levels of public debt, both of the groups clearly lost its control or have been reluctant in controlling the public debt levels. These results can be of a starting point in exploring the possible *self-enforcing effect* or the *Entitlement effect* of public debt.

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[25] The difference in the strength of the *Keynesian Effect* is critical in analyzing and comparing the efficacy of the threshold level effect which will be discussed in the next subsection.

Lastly, we analyze the validity of the political variable, POL_{it}. As mentioned in the previous section, there are some difficulties in controlling for political status of the countries. Proving the fact, the estimation results show only a limited significance. According to the results, the political variable we have employed is only significant in the real per capita GDP growth rates of the AE. More precisely, it can be interpreted as, a one point higher current political score induces a 0.0365% higher growth rate at 5% significance level. Unlike our hypothesis, the political variable we employed appears to have no significant contemporaneous effect on public debt. Further research has to be done in searching for a variable that can precisely proxy the decision-making process of the fiscal policy of the countries including the use of an effective Instrumental Variable.

Overall, the estimation results of the baseline specifications demonstrate the significance of the one-way causality (public debt to real growth rate) of the two key variables and the validity of the contemporaneous threshold level effects of public debt on growth (60% for AE and 90% for EME). Both groups show similar overall pattern of the public debt dynamics where the public debt significantly affects the grow rate in general, but has a clear negative effect on the growth rate when exceeding their corresponding threshold levels. The self-enforcing effect of the public debt is also supported by the model. However, some of the results are not quite clear which lead us to future research, namely, methods to control for the political status of the economies.

Table 1. The results of the baseline specifications
(Advanced Economies, 1955-2008)

Fixed Effects Model

	Lag Length = 1		Lag Length = 2	
Dependent Variables	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}
Y_{it-1}	-0.0691	-0.108*	-0.110**	-0.0133
	(0.0468)	(0.0618)	(0.0555)	(0.0627)
Y_{it-2}	----	----	-0.332***	0.0874
			(0.0249)	(0.0695)
D_{it-1}	0.00966**	0.939***	0.0574***	1.316***
	(0.00440)	(0.0127)	(0.0186)	(0.0625)
D_{it-2}	----	----	-0.0460**	-0.374***
			(0.0183)	(0.0601)
$(Y_{it} - Y_{it-5})$	0.199***	-0.172***	0.281***	-0.161***
	(0.0142)	(0.0377)	(0.0111)	(0.0327)
$D60_{it}$	-0.255	2.280***	-0.349**	1.736***
	(0.159)	(0.470)	(0.167)	(0.404)
$D90_{it}$	-0.216	0.979	-0.262	1.068*
	(0.205)	(0.886)	(0.192)	(0.640)
POL_{it}	0.0449**	0.0121	0.0365**	0.00506
	(0.0192)	(0.00736)	(0.0170)	(0.00644)
Constant	-1.243***	3.446***	-1.364***	3.724***
	(0.348)	(0.917)	(0.349)	(0.561)
Observations	1,060	1,060	1,040	1,040
R-Squared	0.5374	0.9844	0.5837	0.9864
Number of COUN	20	20	20	20

Notes. The full listings of the results including the year- and country- specific dummy variables are reported in the Appendix.
Robust standard errors in parentheses, * Significance at 10%, ** Significance at 5%, * Significance at 1%.**
All coefficients are in percentage terms.
y_{it-j} = The growth rate of per capita GDP of country *i* at time *t-j* (in real value, 1990 Geary-Khamis Dollars).
D_{it-1} = Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t-j*.
$(y_{it} - y_{it-5})$ = Log real growth rate of per capita GDP of country *i* from time *t-5* to *t*.
$D60_{it}$ = Dummy variable that takes value 1 if $D_{it} > 60\%$ and 0 otherwise.
$D90_{it}$ = Dummy variable that takes value 1 if $D_{it} > 90\%$ and 0 otherwise.
POL_{it} = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy of country *i* at time *t*.

Table 2. The results of the baseline regressions
(Emerging Market Economies, 1970-2008)

Fixed Effects Model

	Lag Length = 1		Lag Length = 2	
Dependent Variables	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}
Y_{it-1}	-2.77e-05	-0.0460	-0.0593	0.169
	(0.0442)	(0.173)	(0.0534)	(0.172)
Y_{it-2}	----	----	-0.379***	0.287*
			(0.0298)	(0.154)
D_{it-1}	0.0360***	0.509***	0.0186*	0.635***
	(0.0113)	(0.0766)	(0.0109)	(0.124)
D_{it-2}	----	----	0.0180***	-0.164*
			(0.00664)	(0.0955)
$(Y_{it} - Y_{it-5})$	0.170***	-0.0887*	0.263***	-0.163***
	(0.0173)	(0.0528)	(0.0160)	(0.0599)
$D60_{it}$	-0.492	16.94***	-0.384	17.37***
	(0.549)	(2.506)	(0.519)	(2.522)
$D90_{it}$	-1.538***	28.44***	-1.548**	28.66***
	(0.537)	(5.263)	(0.633)	(5.407)
POL_{it}	0.0644*	-0.383	0.0561	-0.374
	(0.0358)	(0.275)	(0.0353)	(0.283)
Constant	-1.164**	10.89***	-1.148**	10.75***
	(0.506)	(2.081)	(0.577)	(2.156)
Observations	532	532	518	518
R-Squared	0.4027	0.8752	0.4808	0.8803
Number of COUN	14	14	14	14

Notes. The full listings of the results including the year- and country- specific dummy variables are reported in the Appendix.
Robust standard errors in parentheses, * Significance at 10%, ** Significance at 5%, * Significance at 1%.**
All coefficients are in percentage terms.
y_{it-j} = The growth rate of per capita GDP of country *i* at time *t-j* (in real value, 1990 Geary-Khamis Dollars).
D_{it-1} = Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t-j*.
$(y_{it} - y_{it-5})$ = Log real growth rate of per capita GDP of country *i* from time *t-5* to *t*.
$D60_{it}$ = Dummy variable that takes value 1 if $D_{it} > 60\%$ and 0 otherwise.
$D90_{it}$ = Dummy variable that takes value 1 if $D_{it} > 90\%$ and 0 otherwise.
POL_{it} = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy of country *i* at time *t*.

3.2 The results of the additional specifications

In this subsection, we now carry our analysis further to explore the intertemporal dynamics of the threshold level effect on public debt and growth. The Tables 3 and 4 reports the estimation results of Eq. (4) and Eq. (5) for the AE and the EME respectively. The main logic behind estimating this additional specifications is that by considering the interaction terms of the fiscal variable, D_{it-j} and the dummy variables $D60_{it-j}$ and $D90_{it-j}$, we are able to further analyze the dynamics of public debt and growth after an economy reaches the corresponding threshold levels as oppose to the baseline specification which only considers the contemporaneous effects of the threshold levels.

As mentioned above, the main focus of this analysis is to get a hindsight of the intertemporal effects of the threshold levels on the dynamics of public debt and growth. Therefore, our focus is more on the direction of the estimated coefficients rather than the statistical significances of them. Although, it is evident from the estimation results that the most of the coefficients of the interaction variables are not statistically significant, it remains to be worthwhile to investigate since the directions of the coefficients enable us to intuitively understand the intertemporal dynamics of public debt and growth. Furthermore, since our model is under a panel VAR framework, the statistical significances of the coefficients are not as critical as estimating other long-term oriented regressions.

In Column (3) and (4) of Table 3, which is the AE case, the fiscal variable, D_{it-j}, is interacted with the dummy variable $D60_{it-j}$. We investigate the marginal[26] threshold level effect of 60% in the AE case, since the 60% level appears to be the meaningful one for the AE based on the results of the baseline regressions of Table 1. First, the lag 1 interaction variable, $D60_{it-1} * D_{it-1}$ affects the growth by +0.0024% which implies that an additional percentage increase in the public debt-to-GDP ratio above the 60% level marginally increases the next period real per capita GDP growth rate by 0.0024%. The lag 2 interaction variable, $D60_{it-2} * D_{it-2}$ on the other hand, decreases the growth by 0.0081%, which implies that an additional 1% above the 60% level in public debt-to-GDP ratio

[26] By using the term, *marginal threshold level effect*, we refer to the effect of the additional increase in public debt on growth in excess of the specified threshold levels. More precisely, the estimated coefficients of $D60_{it-j}$ *or* $D90_{it-j} * y_{it-j}$ captures the pure effect of the threshold level away from the general effect of the public debt on growth.

marginally decreases the growth in two years ahead of time by 0.0081%. By summing the two estimated coefficients of the interaction terms, we obtain the corresponding total marginal threshold level effect which amounts to -0.0057% for 1% additional increase in public debt-to-GDP ratio exceeding the 60% level. In other words, the marginal effect of an increase in public debt-to-GDP ratio of 10% exceeding the total of 60%, would demise the real per capita growth by -0.057% which is certainly not a negligible amount since the public debt ratios tend to require a relatively long time to change.

Unlike the AE case of, we focus on the marginal threshold level effect of 90% in the EME case since it appears to be the significant threshold level in the estimation results of Table 2. The estimation results of the case of the EME are shown in Table 4. A similar logic of analysis to the AE case applies here also. Column (5) of Table 4 reports the case in interest. The estimated coefficient of the lag 1 interaction variable $D90_{it-1} * D_{it-1}$ is -0.005% and the corresponding coefficient of lag 2 interaction variable is 0.0079%. The sum of the two coefficients, and hence the total marginal threshold level effect amounts to 0.002%. A positive marginal effect of the threshold level on growth is evident among the EME unlike the AE which encounters a negative marginal threshold effect.

Next, we carry our analysis to the dynamics of the marginal threshold level effect of public debt on the future public debt. As previously mentioned, we focus on threshold level effect of 60% for the AE and 90% for the EME (shown in Column (4) and (6) of Table 3 in the AE case and Column (4) and (6) of Table 4 in the EME case). The marginal threshold level effect of public debt on future public debt level of the AE amounts to 0.0027% where the EME equivalent amounts to -0.0966%.

Overall, the results of the additional specifications demonstrate the results of the following. First, the AE encounters a negative marginal impact of -0.057% on future growth and a positive marginal impact of 0.0027% on the future public debt-to-GDP ratio after exceeding the public debt-to-GDP ratio of 60%. The EME encounters a positive impact of 0.002% on growth and a negative impact of -0.0966% on the future public debt-to-GDP ratio after exceeding the public debt-to-GDP ratio of 90%.

The implications of the results imply that the threshold level effect exists among the AE which drives the AE economy to a detrimental situation where their growth rates decrease and the public

debt ratios increase both contemporaneously and intertemporally after its public debt-to-GDP ratio exceeds the level. In the EME case however, the threshold level only exists in contemporaneous terms. This difference in effectiveness of the threshold levels is thought to be mainly caused by the difference in strengths and effectiveness of the *Keynesian Effect* of government spending. The results outlined in the previous two sections may propose the possibility of the *decreasing marginal returns* in government spending.

Table 3. Advanced Economies (1955-2008)

	Without Interaction		D60 Interaction		D90 Interaction	
Dependent Variables	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6)D_{it}
Y_{it-1}	-0.110**	-0.0133	-0.117*	-0.00905	-0.114**	-0.0135
	(0.0555)	(0.0627)	(0.063)	(0.072)	(0.058)	(0.066)
$D(x)_{it-1} * Y_{it-1}$	----	----	0.0438	-0.0571	0.148	-0.134
			(0.083)	(0.133)	(0.092)	(0.352)
Y_{it-2}	-0.332***	0.0874	-0.335***	0.0875	-0.333***	0.0862
	(0.0249)	(0.0695)	(0.030)	(0.073)	(0.025)	(0.067)
$D(x)_{it-2} * Y_{it-2}$	----	----	0.00851	-0.0115	0.0918	0.0289
			(0.051)	(0.088)	(0.098)	(0.269)
D_{it-1}	0.0574***	1.316***	0.0454**	1.358***	0.0502***	1.356***
	(0.0186)	(0.0625)	(0.020)	(0.067)	(0.018)	(0.062)
$D(x)_{it-1} * D_{it-1}$	----	----	0.00239	0.00184	-0.00348	0.0139**
			(0.005)	(0.010)	(0.005)	(0.006)
D_{it-2}	-0.0460**	-0.374***	-0.0346*	-0.388***	-0.0453***	-0.389***
	(0.0183)	(0.0601)	(0.019)	(0.069)	(0.017)	(0.063)
$D(x)_{it-2} * D_{it-2}$	----	----	-0.00805*	0.000988	-0.00069	-0.00731
			(0.005)	(0.011)	(0.006)	(0.011)
$(Y_{it} - Y_{it-5})$	0.281***	-0.161***	0.281***	-0.157***	0.279***	-0.157***
	(0.0111)	(0.0327)	(0.012)	(0.036)	(0.011)	(0.034)
POL_{it}	0.0365**	0.00506	0.0365**	0.00202	0.0367**	0.00206
	(0.0170)	(0.00644)	(0.017)	(0.005)	(0.016)	(0.006)
Constant	-1.364***	3.724***	-1.316***	2.972***	-1.123***	3.162***
	(0.349)	(0.561)	(0.308)	(0.525)	(0.313)	(0.578)
Observations	1,040	1,040	1,040	1,040	1,040	1,040
R-Squared	0.5837	0.9864	0.6181	0.9909	0.5881	0.9865
Number of COUN	20	20	20	20	20	20

Notes. The full listings of the results including the year- and country- specific dummy variables are reported in the Appendix.
Robust standard errors in parentheses, * Significance at 10%, ** Significance at 5%, * Significance at 1%.**
All coefficients are in percentage terms.
All of the variables used are identical to Table 1, Table 2, except for the following variables.
$D60_{it-j}$ **or** $D90_{it-j} * y_{it-j} =$ **Interaction term of the variables** $D60_{it-j}$ **or** $D90_{it-j}$ **and** y_{it-j}**, of country *i* at time *t*.**
$D60_{it-1}$ **or** $D90_{it-1} * D_{it-1} =$ **Interaction term of the variables** $D60_{it-j}$ **or** $D90_{it-j}$ **and** D_{it-j}**, of country *i* at time *t*.**

Table 4. Emerging Markets Economies (1970-2008)

	Without Interaction		D60 Interaction		D90 Interaction	
Dependent Variables	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6)D_{it}
Y_{it-1}	-0.0593	0.169	-0.0642	0.108	-0.0447	0.0643
	(0.0534)	(0.172)	(0.063)	(0.183)	(0.057)	(0.191)
$D(x)_{it-1} * Y_{it-1}$	----	----	0.0316	-0.15	-0.122	0.11
			(0.097)	(0.519)	(0.084)	(0.936)
Y_{it-2}	-0.379***	0.287*	-0.394***	0.382**	-0.392***	0.270*
	(0.0298)	(0.154)	(0.035)	(0.193)	(0.032)	(0.163)
$D(x)_{it-2} * Y_{it-2}$	----	----	0.0521	-0.014	0.0985	0.798
			(0.077)	(0.409)	(0.073)	(0.855)
D_{it-1}	0.0186*	0.635***	0.0053	0.999***	0.0065	0.968***
	(0.0109)	(0.124)	(0.013)	(0.069)	(0.017)	(0.109)
$D(x)_{it-1} * D_{it-1}$	----	----	0.00111	-0.0425	-0.000574	-0.0189
			(0.009)	(0.056)	(0.010)	(0.056)
D_{it-2}	0.0180***	-0.164*	0.0319*	-0.138*	0.0107	-0.0797
	(0.00664)	(0.0955)	(0.017)	(0.072)	(0.013)	(0.124)
$D(x)_{it-2} * D_{it-2}$	----	----	-0.0125	-0.00355	0.00786	-0.0777*
			(0.009)	(0.042)	(0.008)	(0.042)
$(Y_{it} - Y_{it-5})$	0.263***	-0.163***	0.271***	-0.304***	0.271***	-0.313***
	(0.0160)	(0.0599)	(0.016)	(0.091)	(0.016)	(0.097)
POL_{it}	0.0561	-0.374	0.0619*	-0.157	0.0558	-0.22
	(0.0353)	(0.283)	(0.032)	(0.237)	(0.041)	(0.229)
Constant	-1.148**	10.75***	-1.139**	0.899	-0.712	0.771
	(0.577)	(2.156)	(0.550)	(1.380)	(0.559)	(1.564)
Observations	518	518	518	518	518	518
R-Squared	0.4808	0.8803	0.5163	0.8539	0.5169	0.8563
Number of COUN	14	14	14	14	14	14

Notes. The full listings of the results including the year- and country- specific dummy variables are reported in the Appendix.
Robust standard errors in parentheses, * Significance at 10%, ** Significance at 5%, * Significance at 1%.**
All coefficients are in percentage terms.
All of the variables used are identical to Table 1 and Table 2, except for the following variables.
$D(x)_{it-j} * Y_{it-j}$ **Interaction term of the variables** $D60_{it-j}$ **or** $D90_{it-j}$ **and** y_{it-j}**, of country *i* at time *t*.**
$D(x)_{it-j} * D_{it-j}$ **Interaction term of the variables** $D60_{it-j}$ **or** $D90_{it-j}$ **and** D_{it-j}**, of country *i* at time *t*.**

4. Summary and Conclusion

This paper attempts to advance the discussions of the previous literatures on the dynamics of public debt and growth. Despite the fact that there had been numerous studies on the topic, the issue of the non-linearity of public debt appears to be vague. By approaching the issue with a panel VAR method with proper controls, this study offers some constructive results.

First, as oppose to the previous literatures which left question marks on the causal relationship between public debt and growth, the baseline regressions of our panel VAR model is able to provide relatively clear look on the fact that the public debt affects the growth, but growth has less to no effect on public debt levels. This result then allows us to examine the existence of the threshold level in public debt.

By adding the threshold level dummy variables of 60% and 90%, we obtain the result that the threshold levels contemporaneously exist among the AE and the EME but the two groups encounter different levels at 60% for the AE and 90% for the EME. It is a dissimilar result from what had been proposed by Reinhart and Rogoff (2010) in which case the proposed threshold levels of AE and the EME is the same at 90%.

The fact that the 60% threshold level of public debt being significant for the AE is consistent with the Stability and Growth Pact (SGP) of the European Monetary Union (EMU). Regardless of the criticisms on the SGP that had been claimed by numerous studies, our results suggest that implementing fiscal rules such as SGP has its validity at least in terms of securing the growth rates. The EME encounters higher threshold level of 90%, but the negative impact of exceeding the threshold level on its growth is much severe compared to the AE case which can be considered as a consequence of the higher borrowing cost that the EME governments encounter.

By estimating the additional specifications, we obtain the dynamics of the marginal threshold level effect. The estimation results demonstrate rather surprising dynamics of the two variables when the public debt ratios exceed the proposed threshold levels of public debt. First, the impact of the additional increase in public debt ratio beyond the 60% level on the future real per capita growth rate

is significantly negative where the same effect on the future public debt ratio is positive for the AE. In other words, the additional increase in current public debt ratio above the 60% threshold level forces the future growth rate downward and the future public debt ratio upward which puts the AE in a detrimental situation.

In the EME case, the opposite holds true. Although, the growth rates of the EME receives a negative contemporaneous effect of the 90% threshold level, the EME were able to manage the situation to bring the growth rates back up and to bring the public debt ratio down in the future periods. In other words, the threshold level effect seems to fade away as the time passes for the EME.

The main reason behind the difference of the dynamics between the AE and the EME are thought to be caused by the effectiveness in the degree of the *Keynesian Effect* that each groups encounter. By referring to the estimation results of the baseline regressions, it is evident that the EME experience clear positive effects of the public debt on growth in both lags, where the lag 1 and lag 2 effects of the public debt on growth in the AE case almost cancels out one another. More simply, the EME clearly stimulates the growth by increasing the public debt (hence, stronger *Keynesian Effect*), where the AE encounters comparatively weaker stimulation on the growth (hence, weaker *Keynesian Effect*). In fact, the AE experiences a *Non-Keynesian Effect* when the public debt ratio exceeds the 60% threshold level.

The difference in the relative strengths of the *Keynesian Effect* among the two groups may suggest that there exists a *decreasing marginal returns* in government spending. By dividing the sample countries into two different groups and controlling for the growth stages, our model was able to capture the possibility of the fact that *Keynesian Effects* may take effect in different magnitudes depending on the overall stages of economy. The *decreasing marginal returns* then plays a decisive role in determining whether the threshold level effects of public debt levels exist or not in an economy.

Overall, the main contribution of this paper comes from the fact that it used econometric tools to carry the discussions of the existence of the threshold level in public debt further and examining its role in the dynamics of the public debt and growth. The further research is required in explaining the proposed results including the role of interests rates in the public debt-growth dynamics and exploring the role of the political decision-making system of the economies.

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Appendix

Table 5. The results of the Akaike Information Criterion

	Advanced Economies	Emerging Markets Economies
Lag 1 Model	275.1163	177.0608
Lag 2 Model	269.9085*	169.0362*

The above results are derived by the following methodology.

$$\boldsymbol{AIC = T\ ln|\Sigma| + 2N}$$

where,
T = Number of usable observations
N =Total number of parameters estimated in all equations
$|\boldsymbol{\Sigma}|$ = Determinant of the variance-covariance matrix of the residuals

The Variance-covariance Matrix of the residuals, $|\boldsymbol{\Sigma}|$, are derived with Robust Variance-Covariance Estimator. All of the results shown above support for the lag 2 model

Table 6. The Hausman Specification Test

	Advanced Economies	Emerging Market Economies
$\boldsymbol{Y_{it}}$ **Regression**	Chi-squared = 18.58 Prob > Chi-squared = 0.0173	Chi-squared = 7.76 Prob > Chi-squared = 0.4574
$\boldsymbol{D_{it}}$ **Regression**	Chi-Squared = 33.35 Prob > Chi-squared = 0.0001	Chi-squared = 23.50 Prob > Chi-squared = 0.0028

All of the results above support for the Fixed Effects Regression with the only exception being the $\boldsymbol{Y_{it}}$ regression of the Emerging Market Economies. However, since the country-specific dummy variables are controlled in the regressions, this comes of a less important factor of consideration.

Table 7.The full listings of the baseline specifications results (Advanced Economies, 1955 - 2008).

	Random Effects Model				Fixed Effects Model			
	Lag Length = 1		Lag Length = 2		Lag Length = 1		Lag Length = 2	
VARIABLES	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6) D_{it}	(7) Y_{it}	(8) D_{it}
Y_{it-1}	-0.000395	-0.187***	-0.0171	-0.0722	-0.0691	-0.108*	-0.110**	-0.0133
	(0.0507)	(0.0554)	(0.0616)	(0.0558)	(0.0468)	(0.0618)	(0.0555)	(0.0627)
Y_{it-2}	----	----	-0.364***	0.143**	----	----	-0.332***	0.0874
			(0.0263)	(0.0596)			(0.0249)	(0.0695)
D_{it-1}	0.00814**	0.927***	0.0698***	1.442***	0.00966**	0.939***	0.0574***	1.316***
	(0.00414)	(0.0124)	(0.0202)	(0.0633)	(0.00440)	(0.0127)	(0.0186)	(0.0625)
D_{it-2}	----	----	-0.0580***	-0.492***	----	----	-0.0460**	-0.374***
			(0.0181)	(0.0582)			(0.0183)	(0.0601)
$(Y_{it} - Y_{it-5})$	0.192***	-0.179***	0.277***	-0.112***	0.199***	-0.172***	0.281***	-0.161***
	(0.0125)	(0.0277)	(0.00874)	(0.0231)	(0.0142)	(0.0377)	(0.0111)	(0.0327)
D60	-0.163	2.457***	-0.270	1.637***	-0.255	2.280***	-0.349**	1.736***
	(0.193)	(0.471)	(0.194)	(0.452)	(0.159)	(0.470)	(0.167)	(0.404)
D90	-0.302	1.906**	-0.502***	1.965***	-0.216	0.979	-0.262	1.068*
	(0.198)	(0.838)	(0.186)	(0.466)	(0.205)	(0.886)	(0.192)	(0.640)
POL	0.0478**	0.00489	0.0405**	-0.00116	0.0449**	0.0121	0.0365**	0.00506
	(0.0209)	(0.00601)	(0.0168)	(0.00705)	(0.0192)	(0.00736)	(0.0170)	(0.00644)
D_AUS					0.202**	-2.219***	0.245***	-1.871***
					(0.0871)	(0.267)	(0.0834)	(0.202)
D_AUT					0.0110	1.345***	-0.133**	0.598***
					(0.0679)	(0.274)	(0.0642)	(0.197)
D_BEL					-0.0458	1.191***	-0.121	1.007***
					(0.0921)	(0.454)	(0.0744)	(0.302)
D_CAN					-0.0192	-0.462***	-0.0638**	-0.312***
					(0.0261)	(0.0835)	(0.0281)	(0.0683)
D_DEN					0.150***	-0.635***	0.141***	-0.691***
					(0.0539)	(0.140)	(0.0473)	(0.101)
D_FIN					0.230**	-0.114	0.167*	-0.548***
					(0.0990)	(0.308)	(0.0874)	(0.212)

D_FRA	0.175***	0.562***	0.0653	0.0271
	(0.0592)	(0.190)	(0.0600)	(0.141)
D_GER	0.0718	-0.319	0.0260	-0.839***
	(0.119)	(0.361)	(0.108)	(0.248)
D_GRE	0.288***	2.809***	0.0321	1.713***
	(0.100)	(0.290)	(0.103)	(0.304)
D_IRE	0.238*	0.962**	0.301**	0.843***
	(0.122)	(0.404)	(0.121)	(0.264)
D_ITA	-0.134	2.260***	-0.248***	1.537***
	(0.0869)	(0.377)	(0.0685)	(0.309)
D_JAP	-0.0502	4.667***	-0.328***	3.062***
	(0.104)	(0.349)	(0.102)	(0.344)
D_NETH	-0.121**	-0.0382	-0.118**	0.148
	(0.0532)	(0.173)	(0.0525)	(0.122)
D_NZ	-0.116***	-1.537***	-0.117***	-1.112***
	(0.0267)	(0.0921)	(0.0334)	(0.0773)
D_NOR	0.214**	-0.383	0.142*	-0.657***
	(0.0876)	(0.291)	(0.0781)	(0.200)
D_POR	0.477***	1.165***	0.266**	0.358*
	(0.128)	(0.301)	(0.128)	(0.216)
D_SPA	0.608***	0.875***	0.386**	0.343
	(0.156)	(0.337)	(0.150)	(0.226)
D_SWE	0.114***	-0.152	0.0492	-0.376***
	(0.0363)	(0.114)	(0.0322)	(0.0770)
D_UK	-0.0392	-1.484***	0.0218	-0.890***
	(0.0296)	(0.165)	(0.0364)	(0.0963)
D_1960	1.937***	-1.256**	1.451***	-1.438**
	(0.581)	(0.575)	(0.522)	(0.704)
D_1961	1.761***	-0.855	2.111***	-0.869
	(0.511)	(0.573)	(0.414)	(0.686)
D_1962	1.173**	0.223	1.654***	0.0819
	(0.492)	(0.545)	(0.517)	(0.506)
D_1963	0.554	0.875	0.726	0.343
	(0.489)	(0.769)	(0.613)	(0.654)
D_1964	1.509***	0.216	1.408***	-0.406

	(0.329)	(0.546)	(0.430)	(0.454)
D_1965	0.323	1.036	0.365	0.727
	(0.436)	(0.713)	(0.535)	(0.633)
D_1966	-0.0845	1.702**	0.384	1.112*
	(0.333)	(0.704)	(0.366)	(0.584)
D_1967	-0.126	1.603***	-0.123	0.793
	(0.551)	(0.571)	(0.478)	(0.490)
D_1968	0.951**	1.291	0.735*	0.501
	(0.427)	(0.788)	(0.421)	(0.588)
D_1969	2.006***	0.468	1.789***	-0.281
	(0.521)	(0.660)	(0.491)	(0.648)
D_1970	0.440	-0.163	0.714	-0.752
	(0.512)	(0.774)	(0.548)	(0.674)
D_1971	-0.135	0.496	0.440	0.167
	(0.452)	(0.675)	(0.582)	(0.587)
D_1972	0.867**	1.205*	0.722	0.772
	(0.365)	(0.688)	(0.446)	(0.534)
D_1973	1.258***	0.552	0.932**	-0.193
	(0.386)	(0.454)	(0.470)	(0.395)
D_1974	-0.822	1.074	-0.412	0.510
	(0.543)	(0.747)	(0.554)	(0.830)
D_1975	-1.846***	1.571***	-1.188**	0.864*
	(0.520)	(0.527)	(0.468)	(0.468)
D_1976	1.187***	1.230*	0.628	0.418
	(0.382)	(0.629)	(0.437)	(0.722)
D_1977	0.486	1.200	-0.221	0.314
	(0.587)	(0.815)	(0.608)	(0.683)
D_1978	1.150***	1.678***	1.762***	0.699
	(0.390)	(0.583)	(0.367)	(0.437)
D_1979	1.536***	1.501**	1.501***	0.182
	(0.346)	(0.700)	(0.419)	(0.658)
D_1980	-0.473	1.473**	-0.402	0.266
	(0.398)	(0.733)	(0.462)	(0.556)
D_1981	-0.937***	1.790**	-0.435	0.912
	(0.357)	(0.821)	(0.410)	(0.655)

D_1982	-0.765**	2.377**	-0.805*	1.379**
	(0.361)	(1.056)	(0.420)	(0.692)
D_1983	0.398	3.260***	0.0990	2.051**
	(0.396)	(1.043)	(0.450)	(0.831)
D_1984	1.915***	2.301**	1.608***	0.561
	(0.481)	(0.935)	(0.394)	(0.890)
D_1985	1.563***	3.155***	1.596***	1.692*
	(0.314)	(1.071)	(0.365)	(0.918)
D_1986	0.768***	2.468***	1.096***	0.677
	(0.265)	(0.860)	(0.320)	(0.697)
D_1987	0.635	1.068	0.739	-0.329
	(0.451)	(0.750)	(0.493)	(0.789)
D_1988	1.090**	0.308	1.001**	-0.375
	(0.458)	(0.841)	(0.478)	(0.685)
D_1989	0.707*	-0.297	0.813*	-0.669
	(0.400)	(0.822)	(0.452)	(0.587)
D_1990	-0.490	1.331	-0.00903	1.200
	(0.490)	(1.387)	(0.493)	(1.188)
D_1991	-1.300**	1.256*	-0.954*	0.655
	(0.565)	(0.730)	(0.568)	(0.714)
D_1992	-0.807**	2.637***	-0.840**	2.049***
	(0.389)	(0.791)	(0.406)	(0.703)
D_1993	-0.789	4.262***	-0.983*	3.125***
	(0.542)	(1.014)	(0.513)	(0.812)
D_1994	1.914***	1.874	1.671***	0.0167
	(0.372)	(1.323)	(0.393)	(1.268)
D_1995	1.836***	0.753	1.520***	-0.307
	(0.356)	(0.792)	(0.436)	(0.483)
D_1996	1.115***	0.455	1.626***	-0.291
	(0.307)	(0.826)	(0.318)	(0.636)
D_1997	1.395***	-0.616	1.695***	-1.131**
	(0.356)	(0.737)	(0.407)	(0.495)
D_1998	0.396	-0.656	0.470	-0.675
	(0.456)	(0.651)	(0.470)	(0.492)
D_1999	0.819**	-0.187	1.144***	0.00316

					(0.338)	(0.722)	(0.368)	(0.656)
D_2000					0.921***	-0.106	0.992***	-0.236
					(0.251)	(1.588)	(0.323)	(1.627)
D_2001					-0.791***	0.293	-0.455	0.218
					(0.300)	(0.877)	(0.377)	(0.778)
D_2002					-0.683***	0.966	-0.218	0.884
					(0.258)	(0.724)	(0.285)	(0.579)
D_2003					-0.557**	0.604	-0.656**	0.300
					(0.284)	(0.526)	(0.325)	(0.426)
D_2004					0.652***	0.920	0.573**	0.604
					(0.240)	(0.842)	(0.283)	(0.795)
D_2005					0.739***	0.445	0.738**	-0.121
					(0.241)	(0.862)	(0.297)	(0.599)
D_2006					1.076***	-1.524**	1.336***	-2.024***
					(0.267)	(0.772)	(0.316)	(0.514)
D_2007					0.778***	-1.059	0.992***	-0.780
					(0.302)	(0.876)	(0.331)	(0.550)
D_2008					-1.364***	3.195***	-0.875**	3.325***
					(0.407)	(0.957)	(0.440)	(0.936)
Constant	-0.745***	5.536***	-0.948***	3.140***	-1.243***	3.446***	-1.364***	3.724***
	(0.221)	(0.818)	(0.193)	(0.525)	(0.348)	(0.917)	(0.349)	(0.561)
Observations	1,060	1,060	1,040	1,040	1,060	1,060	1,040	1,040
R-Squared	0.4067	0.9853	0.4829	0.989	0.5374	0.9844	0.5837	0.9864
Number of COUN	20	20	20	20	20	20	20	20

Robust standard errors in parentheses, *Significance at 10%, **Significance at 5%, ***Significance at 1%

All coefficients are in percentage terms.

***Y_{it-j}* = The growth rate of per capita GDP of country *i* at time *t - j* (in real value, 1990 Geary-Khamis Dollars)**

D_{it-j}*= Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t - j

***D60* = A dummy variable that takes value 1 if D_{it} >60% and 0 otherwise.**

***D90* = A dummy variable that takes value 1 if D_{it} > 90% and 0 otherwise.**

***POL* = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy within the country.**

***D_i* = Country *i*- specific dummy variable where *i*=Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Grece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, U.K, U.S**

***D_t* = *The year t*- specific effect, where *t* = 1956, 1957, … , 2008**

Table 8. The full listings of the baseline specifications results (Emerging Market Economies 1970 - 2008).

	Random Effects Model				Fixed Effects Model			
	Lag Length = 1		Lag Length = 2		Lag Length = 1		Lag Length = 2	
VARIABLES	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6) D_{it}	(7) Y_{it}	(8) D_{it}
Y_{it-1}	0.0346	-0.182	-0.0145	0.0388	-2.77e-05	-0.0460	-0.0593	0.169
	(0.0448)	(0.188)	(0.0528)	(0.190)	(0.0442)	(0.173)	(0.0534)	(0.172)
Y_{it-2}	----	----	-0.388***	0.306**	----	----	-0.379***	0.287*
			(0.0225)	(0.135)			(0.0298)	(0.154)
D_{it-1}	0.0366***	0.555***	0.0221**	0.684***	0.0360***	0.509***	0.0186*	0.635***
	(0.0102)	(0.0661)	(0.00945)	(0.117)	(0.0113)	(0.0766)	(0.0109)	(0.124)
D_{it-2}	----	----	0.0129*	-0.150	----	----	0.0180***	-0.164*
			(0.00696)	(0.0933)			(0.00664)	(0.0955)
$(Y_{it} - Y_{it-5})$	0.168***	-0.0940*	0.259***	-0.169***	0.170***	-0.0887*	0.263***	-0.163***
	(0.0157)	(0.0540)	(0.0145)	(0.0619)	(0.0173)	(0.0528)	(0.0160)	(0.0599)
D60	-1.068**	17.87***	-0.886*	18.30***	-0.492	16.94***	-0.384	17.37***
	(0.507)	(2.514)	(0.491)	(2.575)	(0.549)	(2.506)	(0.519)	(2.522)
D90	-1.056	28.35***	-1.079	28.07***	-1.538***	28.44***	-1.548**	28.66***
	(0.690)	(5.420)	(0.729)	(5.448)	(0.537)	(5.263)	(0.633)	(5.407)
POL	0.0602***	-0.168	0.0614***	-0.127	0.0644*	-0.383	0.0561	-0.374
	(0.0126)	(0.164)	(0.0141)	(0.169)	(0.0358)	(0.275)	(0.0353)	(0.283)
D_ARG					-0.196	3.408***	-0.452***	3.854***
					(0.170)	(1.272)	(0.145)	(1.329)
D_BOL					-0.861***	7.741***	-1.085***	8.728***
					(0.240)	(2.022)	(0.242)	(2.147)
D_BRA					-0.333	5.247***	-0.660***	5.614***
					(0.212)	(1.429)	(0.184)	(1.525)
D_CHL					0.493**	-1.748*	0.105	-2.050**
					(0.238)	(0.899)	(0.213)	(0.955)
D_COL					0.517***	-1.716**	0.359**	-2.524***
					(0.180)	(0.726)	(0.173)	(0.798)
D_EGY					0.120	2.900	-0.248	3.577
					(0.398)	(3.457)	(0.376)	(3.670)

D_IND	0.246	5.646***	0.138	5.224***
	(0.226)	(0.744)	(0.191)	(0.810)
D_INDN	0.259	1.851	0.0425	1.747
	(0.278)	(2.085)	(0.247)	(2.111)
D_MAL	-0.00262	7.101***	-0.397	7.215***
	(0.322)	(1.857)	(0.277)	(2.027)
D_MEX	0.141	0.629	-0.0740	0.781
	(0.240)	(1.553)	(0.214)	(1.598)
D_PHI	-0.0793	2.083*	-0.354**	2.371*
	(0.140)	(1.186)	(0.167)	(1.243)
D_THL	-0.838	8.153**	-1.211**	9.489**
	(0.564)	(3.903)	(0.484)	(4.096)
D_URG	0.0359	2.481**	-0.190	2.851**
	(0.157)	(1.047)	(0.136)	(1.112)
D_1975	-0.605	4.158**	0.0887	5.221***
	(1.487)	(1.671)	(1.418)	(1.827)
D_1976	2.060**	1.634	1.995*	1.835
	(0.977)	(1.953)	(1.070)	(1.871)
D_1977	1.163	3.817	0.606	4.736**
	(1.193)	(2.680)	(1.140)	(2.345)
D_1978	0.490	3.282**	1.225	3.149**
	(1.009)	(1.498)	(1.048)	(1.486)
D_1979	-0.141	1.807	0.303	2.122
	(1.026)	(2.879)	(1.207)	(2.940)
D_1980	-0.387	-0.455	-0.417	0.549
	(0.856)	(3.178)	(0.961)	(2.993)
D_1981	-1.606	4.179*	-1.547*	5.552**
	(1.101)	(2.533)	(0.870)	(2.246)
D_1982	-4.098**	9.541***	-3.413**	9.814***
	(1.652)	(3.271)	(1.461)	(3.224)
D_1983	-2.313**	11.11***	-2.048*	11.59***
	(1.127)	(4.059)	(1.133)	(4.270)
D_1984	-0.721	8.568***	-1.462	10.03***
	(1.342)	(2.968)	(1.181)	(3.072)
D_1985	-1.485	11.56***	-1.375	13.10***

	(1.403)	(3.769)	(1.248)	(4.399)
D_1986	1.420	19.41***	1.948	20.50***
	(1.097)	(5.673)	(1.196)	(5.437)
D_1987	0.866	13.64**	0.758	13.84**
	(0.658)	(6.396)	(0.746)	(5.456)
D_1988	0.0553	-5.090	0.548	-3.506
	(1.507)	(5.184)	(1.392)	(4.763)
D_1989	-0.825	3.455	-0.615	8.351**
	(1.130)	(5.341)	(1.174)	(3.529)
D_1990	-1.351	6.657*	-1.079	9.363**
	(1.034)	(3.559)	(1.159)	(3.983)
D_1991	-0.805	5.249**	-1.044	8.292***
	(1.143)	(2.582)	(0.770)	(2.595)
D_1992	0.208	4.449*	0.0569	6.675***
	(0.874)	(2.316)	(0.878)	(2.387)
D_1993	-0.292	7.604***	-0.172	9.023***
	(0.565)	(2.818)	(0.634)	(3.031)
D_1994	0.443	5.395*	0.741	6.502**
	(0.770)	(3.044)	(0.818)	(3.094)
D_1995	-0.933	3.899	-0.898	5.548**
	(1.385)	(2.909)	(1.333)	(2.714)
D_1996	-0.0519	3.169	0.257	4.867
	(0.620)	(3.253)	(0.679)	(3.088)
D_1997	0.152	4.084*	-0.0904	6.158***
	(0.725)	(2.261)	(0.757)	(2.154)
D_1998	-3.164**	10.33***	-2.636**	10.85***
	(1.477)	(2.104)	(1.336)	(2.087)
D_1999	-2.446**	7.755***	-1.661*	7.931***
	(1.078)	(1.933)	(0.882)	(2.232)
D_2000	0.175	7.009**	-0.535	8.998***
	(0.925)	(2.919)	(0.752)	(3.070)
D_2001	-1.793	10.69***	-2.011*	12.32***
	(1.164)	(2.921)	(1.197)	(2.958)
D_2002	-2.170*	12.62**	-0.969	12.89**
	(1.251)	(5.290)	(1.266)	(5.472)

D_2003					0.575	7.477***	0.589	8.356***
					(0.875)	(2.498)	(0.973)	(2.632)
D_2004					2.828**	5.671***	1.833*	8.321***
					(1.392)	(1.521)	(1.050)	(1.769)
D_2005					1.077	2.968	1.368*	4.773*
					(0.942)	(2.527)	(0.788)	(2.715)
D_2006					1.118	3.890	2.065*	6.088**
					(0.779)	(2.931)	(1.063)	(2.898)
D_2007					0.228	7.400***	0.201	9.578***
					(0.615)	(2.818)	(0.677)	(2.693)
D_2008					-1.321**	6.302***	-1.218*	7.900***
					(0.611)	(2.124)	(0.664)	(2.209)
Constant	-1.492***	16.30***	-1.544***	16.82***	-1.164**	10.89***	-1.148**	10.75***
	(0.378)	(2.087)	(0.361)	(2.316)	(0.506)	(2.081)	(0.577)	(2.156)
Observations	532	532	518	518	532	532	518	518
R-Squared	0.2892	0.8515	0.3827	0.8559	0.4027	0.8752	0.4808	0.8803
Number of COUN	14	14	14	14	14	14	14	14

Robust standard errors in parentheses, *Significance at 10%, **Significance at 5%, ***Significance at 1%
All coefficients are in percentage terms.
Y_{it-j}= The growth rate of per capita GDP of country *i* at time *t - j* (in real value, 1990 Geary-Khamis Dollars)
D_{it-j} = Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t - j*
***D60* = A dummy variable that takes value 1 if D_{it} > 60% and 0 otherwise.**
***D90* = A dummy variable that takes value 1 if D_{it} > 90% and 0 otherwise.**
***POL* = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy within the country**
***D_i* = Country *i*- specific dummy variable where *i*= Argentina, Bolivia, Brazil, Chile, Columbia, Egypt, India, Indonesia, Malaysia, Mexico, Philippines, Thailand, Uruguay**
***D_t* = The year *t*- specific effect, where *t* = 1971, 1972, … , 2008**

Table 9. The full listings of the additional specifications result (Advanced Economies, 1955 - 2008).

	Without Interaction		D60 Interaction		D90 Interaction	
VARIABLES	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6) D_{it}
Y_{it-1}	-0.110**	-0.0133	-0.117*	-0.00905	-0.114**	-0.0135
	(0.0555)	(0.0627)	(0.063)	(0.072)	(0.058)	(0.066)
$D(x)_{it-1} * Y_{it-1}$	----	----	0.0438	-0.0571	0.148	-0.134
			(0.083)	(0.133)	(0.092)	(0.352)
Y_{it-2}	-0.332***	0.0874	-0.335***	0.0875	-0.333***	0.0862
	(0.0249)	(0.0695)	(0.030)	(0.073)	(0.025)	(0.067)
$D(x)_{it-2} * Y_{it-2}$	----	----	0.00851	-0.0115	0.0918	0.0289
			(0.051)	(0.088)	(0.098)	(0.269)
D_{it-1}	0.0574***	1.316***	0.0454**	1.358***	0.0502***	1.356***
	(0.0186)	(0.0625)	(0.020)	(0.067)	(0.018)	(0.062)
$D(x)_{it-1} * D_{it-1}$	----	----	0.00239	0.00184	-0.00348	0.0139**
			(0.005)	(0.010)	(0.005)	(0.006)
D_{it-2}	-0.0460**	-0.374***	-0.0346*	-0.388***	-0.0453***	-0.389***
	(0.0183)	(0.0601)	(0.019)	(0.069)	(0.017)	(0.063)
$D(x)_{it-2} * D_{it-2}$	----	----	-0.00805*	0.000988	-0.00069	-0.00731
			(0.005)	(0.011)	(0.006)	(0.011)
$(Y_{it} - Y_{it-5})$	0.281***	-0.161***	0.281***	-0.157***	0.279***	-0.157***
	(0.0111)	(0.0327)	(0.012)	(0.036)	(0.011)	(0.034)
POL	0.0365**	0.00506	0.0365**	0.00202	0.0367**	0.00206
	(0.0170)	(0.00644)	(0.017)	(0.005)	(0.016)	(0.006)
D_AUS	0.245***	-1.871***	0.253***	-1.604***	0.174**	-1.673***
	(0.0834)	(0.202)	(0.092)	(0.125)	(0.079)	(0.146)
D_AUT	-0.133**	0.598***	-0.103**	0.554***	-0.130**	0.498***
	(0.0642)	(0.197)	(0.053)	(0.150)	(0.062)	(0.161)
D_BEL	-0.121	1.007***	-0.139**	1.269***	-0.183**	1.211***
	(0.0744)	(0.302)	(0.068)	(0.250)	(0.079)	(0.253)
D_CAN	-0.0638**	-0.312***	-0.0383*	-0.288***	-0.0651***	-0.249***
	(0.0281)	(0.0683)	(0.021)	(0.067)	(0.021)	(0.061)
D_DEN	0.141***	-0.691***	0.137**	-0.314***	0.056	-0.341***

	(0.0473)	(0.101)	(0.059)	(0.096)	(0.036)	(0.073)
D_FIN	0.167*	-0.548***	0.173**	-0.235*	0.0899	-0.319*
	(0.0874)	(0.212)	(0.084)	(0.142)	(0.083)	(0.177)
D_FRA	0.0653	0.0271	0.0693	0.149	0.028	0.101
	(0.0600)	(0.141)	(0.055)	(0.107)	(0.052)	(0.132)
D_GER	0.0260	-0.839***	0.0388	-0.484***	-0.0703	-0.579***
	(0.108)	(0.248)	(0.108)	(0.163)	(0.100)	(0.209)
D_GRE	0.0321	1.713***	0.00838	2.111***	-0.119	1.999***
	(0.103)	(0.304)	(0.095)	(0.276)	(0.121)	(0.338)
D_IRE	0.301**	0.843***	0.274**	1.174***	0.232**	1.166***
	(0.121)	(0.264)	(0.138)	(0.282)	(0.111)	(0.277)
D_ITA	-0.248***	1.537***	-0.254***	1.723***	-0.257***	1.619***
	(0.0685)	(0.309)	(0.058)	(0.265)	(0.075)	(0.302)
D_JAP	-0.328***	3.062***	-0.273***	3.094***	-0.294***	2.994***
	(0.102)	(0.344)	(0.095)	(0.381)	(0.110)	(0.380)
D_NETH	-0.118**	0.148	-0.0990**	0.137	-0.101**	0.176
	(0.0525)	(0.122)	(0.045)	(0.099)	(0.041)	(0.116)
D_NZ	-0.117***	-1.112***	-0.0969**	-1.206***	-0.106***	-1.195***
	(0.0334)	(0.0773)	(0.040)	(0.087)	(0.029)	(0.093)
D_NOR	0.142*	-0.657***	0.154**	-0.503***	0.0988	-0.575***
	(0.0781)	(0.200)	(0.074)	(0.126)	(0.076)	(0.151)
D_POR	0.266**	0.358*	0.278**	0.658***	0.19	0.599***
	(0.128)	(0.216)	(0.128)	(0.216)	(0.120)	(0.229)
D_SPA	0.386**	0.343	0.408***	0.368*	0.376***	0.307
	(0.150)	(0.226)	(0.147)	(0.205)	(0.142)	(0.207)
D_SWE	0.0492	-0.376***	0.0582*	-0.287***	0.0251	-0.318***
	(0.0322)	(0.0770)	(0.031)	(0.052)	(0.029)	(0.065)
D_UK	0.0218	-0.890***	0.0434	-0.942***	0.0178	-0.968***
	(0.0364)	(0.0963)	(0.038)	(0.104)	(0.043)	(0.105)
D_1960	1.451***	-1.438**	1.421***	-1.446**	1.446***	-1.468*
	(0.522)	(0.704)	(0.533)	(0.735)	(0.520)	(0.781)
D_1961	2.111***	-0.869	2.091***	-0.876	2.088***	-0.908
	(0.414)	(0.686)	(0.416)	(0.702)	(0.414)	(0.694)
D_1962	1.654***	0.0819	1.632***	0.11	1.631***	0.0702
	(0.517)	(0.506)	(0.532)	(0.469)	(0.526)	(0.468)

D_1963	0.726	0.343	0.708	0.284	0.746	0.232
	(0.613)	(0.654)	(0.633)	(0.600)	(0.622)	(0.619)
D_1964	1.408***	-0.406	1.427***	-0.615	1.447***	-0.654
	(0.430)	(0.454)	(0.463)	(0.475)	(0.449)	(0.438)
D_1965	0.365	0.727	0.392	0.536	0.383	0.504
	(0.535)	(0.633)	(0.545)	(0.630)	(0.550)	(0.623)
D_1966	0.384	1.112*	0.37	0.942*	0.4	0.941*
	(0.366)	(0.584)	(0.375)	(0.566)	(0.381)	(0.568)
D_1967	-0.123	0.793	-0.129	0.609	-0.0963	0.582
	(0.478)	(0.490)	(0.463)	(0.467)	(0.456)	(0.460)
D_1968	0.735*	0.501	0.718*	0.331	0.761*	0.288
	(0.421)	(0.588)	(0.412)	(0.579)	(0.416)	(0.549)
D_1969	1.789***	-0.281	1.764***	-0.425	1.817***	-0.48
	(0.491)	(0.648)	(0.494)	(0.658)	(0.506)	(0.645)
D_1970	0.714	-0.752	0.692	-0.858	0.738	-0.901
	(0.548)	(0.674)	(0.544)	(0.714)	(0.546)	(0.672)
D_1971	0.440	0.167	0.442	-0.0524	0.48	-0.0962
	(0.582)	(0.587)	(0.594)	(0.597)	(0.593)	(0.580)
D_1972	0.722	0.772	0.744*	0.57	0.753*	0.519
	(0.446)	(0.534)	(0.444)	(0.503)	(0.437)	(0.465)
D_1973	0.932**	-0.193	0.919*	-0.393	0.965**	-0.445
	(0.470)	(0.395)	(0.478)	(0.425)	(0.471)	(0.420)
D_1974	-0.412	0.510	-0.446	0.436	-0.41	0.384
	(0.554)	(0.830)	(0.554)	(0.858)	(0.557)	(0.902)
D_1975	-1.188**	0.864*	-1.242***	0.807*	-1.205***	0.739
	(0.468)	(0.468)	(0.447)	(0.431)	(0.456)	(0.458)
D_1976	0.628	0.418	0.594	0.323	0.61	0.245
	(0.437)	(0.722)	(0.475)	(0.696)	(0.452)	(0.736)
D_1977	-0.221	0.314	-0.226	0.176	-0.226	0.126
	(0.608)	(0.683)	(0.594)	(0.657)	(0.583)	(0.645)
D_1978	1.762***	0.699	1.746***	0.58	1.758***	0.513
	(0.367)	(0.437)	(0.363)	(0.474)	(0.348)	(0.505)
D_1979	1.501***	0.182	1.495***	-0.0185	1.515***	-0.0821
	(0.419)	(0.658)	(0.436)	(0.643)	(0.421)	(0.641)
D_1980	-0.402	0.266	-0.398	0.0123	-0.372	-0.0294

	(0.462)	(0.556)	(0.469)	(0.580)	(0.465)	(0.569)
D_1981	-0.435	0.912	-0.46	0.741	-0.428	0.697
	(0.410)	(0.655)	(0.446)	(0.624)	(0.423)	(0.662)
D_1982	-0.805*	1.379**	-0.849*	1.223*	-0.811*	1.187*
	(0.420)	(0.692)	(0.448)	(0.733)	(0.425)	(0.699)
D_1983	0.0990	2.051**	0.0318	2.026***	0.0619	1.999**
	(0.450)	(0.831)	(0.461)	(0.781)	(0.445)	(0.849)
D_1984	1.608***	0.561	1.569***	0.388	1.625***	0.315
	(0.394)	(0.890)	(0.381)	(0.836)	(0.390)	(0.846)
D_1985	1.596***	1.692*	1.545***	1.696*	1.568***	1.680*
	(0.365)	(0.918)	(0.381)	(0.940)	(0.365)	(0.958)
D_1986	1.096***	0.677	1.026***	0.645	1.074***	0.576
	(0.320)	(0.697)	(0.348)	(0.688)	(0.320)	(0.717)
D_1987	0.739	-0.329	0.723	-0.522	0.778	-0.562
	(0.493)	(0.789)	(0.501)	(0.774)	(0.482)	(0.784)
D_1988	1.001**	-0.375	0.991**	-0.511	1.004**	-0.502
	(0.478)	(0.685)	(0.488)	(0.760)	(0.484)	(0.762)
D_1989	0.813*	-0.669	0.752	-0.744	0.753*	-0.787
	(0.452)	(0.587)	(0.474)	(0.620)	(0.439)	(0.586)
D_1990	-0.00903	1.200	-0.0619	1.116	-0.0848	1.094
	(0.493)	(1.188)	(0.491)	(1.171)	(0.463)	(1.162)
D_1991	-0.954*	0.655	-1.037*	0.749	-1.037*	0.752
	(0.568)	(0.714)	(0.589)	(0.772)	(0.589)	(0.746)
D_1992	-0.840**	2.049***	-0.900**	2.055***	-0.877**	2.020***
	(0.406)	(0.703)	(0.410)	(0.735)	(0.400)	(0.709)
D_1993	-0.983*	3.125***	-0.981*	3.040***	-0.979*	3.013***
	(0.513)	(0.812)	(0.536)	(0.885)	(0.522)	(0.878)
D_1994	1.671***	0.0167	1.723***	-0.264	1.772***	-0.295
	(0.393)	(1.268)	(0.402)	(1.315)	(0.407)	(1.323)
D_1995	1.520***	-0.307	1.479***	-0.383	1.563***	-0.388
	(0.436)	(0.483)	(0.466)	(0.559)	(0.473)	(0.539)
D_1996	1.626***	-0.291	1.542***	-0.36	1.629***	-0.384
	(0.318)	(0.636)	(0.324)	(0.634)	(0.329)	(0.634)
D_1997	1.695***	-1.131**	1.677***	-1.307**	1.738***	-1.335***
	(0.407)	(0.495)	(0.399)	(0.510)	(0.421)	(0.491)

D_1998	0.470	-0.675	0.458	-0.874	0.506	-0.878
	(0.470)	(0.492)	(0.485)	(0.586)	(0.470)	(0.566)
D_1999	1.144***	0.00316	1.107***	-0.0973	1.152***	-0.108
	(0.368)	(0.656)	(0.369)	(0.695)	(0.380)	(0.670)
D_2000	0.992***	-0.236	0.977***	-0.555	1.058***	-0.637
	(0.323)	(1.627)	(0.345)	(1.627)	(0.325)	(1.614)
D_2001	-0.455	0.218	-0.431	-0.121	-0.43	-0.15
	(0.377)	(0.778)	(0.389)	(0.936)	(0.379)	(0.878)
D_2002	-0.218	0.884	-0.239	0.558	-0.182	0.484
	(0.285)	(0.579)	(0.299)	(0.554)	(0.283)	(0.544)
D_2003	-0.656**	0.300	-0.719**	0.132	-0.618**	0.0609
	(0.325)	(0.426)	(0.349)	(0.503)	(0.313)	(0.484)
D_2004	0.573**	0.604	0.496	0.426	0.600**	0.382
	(0.283)	(0.795)	(0.314)	(0.870)	(0.280)	(0.804)
D_2005	0.738**	-0.121	0.703**	-0.307	0.741**	-0.353
	(0.297)	(0.599)	(0.299)	(0.631)	(0.297)	(0.604)
D_2006	1.336***	-2.024***	1.325***	-2.279***	1.367***	-2.341***
	(0.316)	(0.514)	(0.312)	(0.558)	(0.321)	(0.561)
D_2007	0.992***	-0.780	0.959***	-0.947*	1.005***	-0.939
	(0.331)	(0.550)	(0.341)	(0.572)	(0.346)	(0.575)
D_2008	-0.875**	3.325***	-0.918**	3.256***	-0.894**	3.225***
	(0.440)	(0.936)	(0.448)	(0.999)	(0.440)	(1.003)
Constant	-1.364***	3.724***	-1.316***	2.972***	-1.123***	3.162***
	(0.349)	(0.561)	(0.308)	(0.525)	(0.313)	(0.578)
Observations	1,040	1,040	1,040	1,040	1,040	1,040
R-Squared	0.5837	0.9864	0.6181	0.9909	0.5881	0.9865
Number of COUN	20	20	20	20	20	20

Robust standard errors in parentheses, *Significance at 10%, **Significance at 5%, ***Significance at 1%
All coefficients are in percentage terms.
***Y_{it-j}*= The log of per capita GDP of country *i* at time *t - j* (in real value, 1990 Geary-Khamis Dollars)**
D_{it-j}* = Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t - j
***D60* = A dummy variable that takes value 1 if D_{it} > 60% and 0 otherwise.**
***D90* = A dummy variable that takes value 1 if D_{it} > 90% and 0 otherwise.**
***$D(x)_{it-j} * Y_{it-j}$* Interaction term of the variables $D60_{it-j}$ *or* $D90_{it-j}$ and Y_{it-j}**
Table 9. (Continued).
***$D(x)_{it-j} * D_{it-j}$* Interaction term of the variables $D60_{it-j}$ *or* $D90_{it-j}$ and D_{it-j}**
***POL* = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy within the country.**

Table 9. (Continued)

D_i= Country *i*- specific dummy variable where *i*=Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Grece, Ireland, Italy, Japan, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, U.K, U.S

D_t= The year t- specific effect, where *t* = 1956, 1957, … , 2008

Table 10. The full listings of the additional specifications result (Emerging Market Economies, 1970 - 2008).

	Without Interaction		D60 Interaction		D90 Interaction	
VARIABLES	(1) Y_{it}	(2) D_{it}	(3) Y_{it}	(4) D_{it}	(5) Y_{it}	(6) D_{it}
Y_{it-1}	-0.0593	0.169	-0.0642	0.108	-0.0447	0.0643
	(0.0534)	(0.172)	(0.063)	(0.183)	(0.057)	(0.191)
$D(x)_{it-1} * Y_{it-1}$	----	----	0.0316	-0.15	-0.122	0.11
			(0.097)	(0.519)	(0.084)	(0.936)
Y_{it-2}	-0.379***	0.287*	-0.394***	0.382**	-0.392***	0.270*
	(0.0298)	(0.154)	(0.035)	(0.193)	(0.032)	(0.163)
$D(x)_{it-2} * Y_{it-2}$	----	----	0.0521	-0.014	0.0985	0.798
			(0.077)	(0.409)	(0.073)	(0.855)
D_{it-1}	0.0186*	0.635***	0.0053	0.999***	0.0065	0.968***
	(0.0109)	(0.124)	(0.013)	(0.069)	(0.017)	(0.109)
$D(x)_{it-1} * D_{it-1}$	----	----	0.00111	-0.0425	-0.000574	-0.0189
			(0.009)	(0.056)	(0.010)	(0.056)
D_{it-2}	0.0180***	-0.164*	0.0319*	-0.138*	0.0107	-0.0797
	(0.00664)	(0.0955)	(0.017)	(0.072)	(0.013)	(0.124)
$D(x)_{it-2} * D_{it-2}$	----	----	-0.0125	-0.00355	0.00786	-0.0777*
			(0.009)	(0.042)	(0.008)	(0.042)
$(Y_{it} - Y_{it-5})$	0.263***	-0.163***	0.271***	-0.304***	0.271***	-0.313***
	(0.0160)	(0.0599)	(0.016)	(0.091)	(0.016)	(0.097)
POL	0.0561	-0.374	0.0619*	-0.157	0.0558	-0.22
	(0.0353)	(0.283)	(0.032)	(0.237)	(0.041)	(0.229)
D_ARG	-0.452***	3.854***	-0.520***	4.003***	-0.524***	4.813***
	(0.145)	(1.329)	(0.158)	(1.302)	(0.183)	(1.266)
D_BOL	-1.085***	8.728***	-1.058***	7.390***	-0.915***	6.663***
	(0.242)	(2.147)	(0.287)	(2.457)	(0.280)	(1.939)
D_BRA	-0.660***	5.614***	-0.769***	5.099***	-0.637***	5.281***

	(0.184)	(1.525)	(0.227)	(1.582)	(0.195)	(1.317)
D_CHL	0.105	-2.050**	0.0112	0.758	-0.0749	1.383
	(0.213)	(0.955)	(0.152)	(0.892)	(0.160)	(1.072)
D_COL	0.359**	-2.524***	0.256***	-0.0158	0.0866	1.444
	(0.173)	(0.798)	(0.098)	(0.876)	(0.153)	(1.013)
D_EGY	-0.248	3.577	-0.563	10.40***	-0.496	10.06***
	(0.376)	(3.670)	(0.425)	(3.522)	(0.444)	(3.331)
D_IND	0.138	5.224***	-0.00956	2.886***	0.0921	4.217***
	(0.191)	(0.810)	(0.188)	(1.113)	(0.126)	(1.169)
D_INDN	0.0425	1.747	-0.0623	0.969	0.0496	1.16
	(0.247)	(2.111)	(0.281)	(1.829)	(0.260)	(1.589)
D_MAL	-0.397	7.215***	-0.608*	7.616***	-0.406	7.714***
	(0.277)	(2.027)	(0.321)	(2.163)	(0.272)	(2.007)
D_MEX	-0.0740	0.781	-0.0997	2.382	-0.17	2.985**
	(0.214)	(1.598)	(0.216)	(1.571)	(0.217)	(1.422)
D_PHI	-0.354**	2.371*	-0.286	5.234***	-0.263	3.766***
	(0.167)	(1.243)	(0.176)	(1.529)	(0.217)	(1.103)
D_THL	-1.211**	9.489**	-1.668***	12.66***	-1.583***	13.37**
	(0.484)	(4.096)	(0.489)	(4.255)	(0.559)	(5.223)
D_URG	-0.190	2.851**	-0.318**	4.458***	-0.300*	4.936***
	(0.136)	(1.112)	(0.146)	(1.169)	(0.158)	(1.149)
D_1975	0.0887	5.221***	0.0248	7.978**	-0.0375	7.796***
	(1.418)	(1.827)	(1.379)	(3.258)	(1.389)	(3.022)
D_1976	1.995*	1.835	2.021*	2.957	1.949*	2.992
	(1.070)	(1.871)	(1.077)	(3.338)	(1.062)	(3.213)
D_1977	0.606	4.736**	0.536	6.032**	0.563	5.719**
	(1.140)	(2.345)	(1.129)	(2.803)	(1.137)	(2.784)
D_1978	1.225	3.149**	1.196	4.359	1.212	4.270*
	(1.048)	(1.486)	(1.022)	(2.659)	(0.996)	(2.481)
D_1979	0.303	2.122	0.215	4.169	0.297	3.669
	(1.207)	(2.940)	(1.218)	(3.934)	(1.236)	(3.900)
D_1980	-0.417	0.549	-0.456	1.573	-0.43	0.7
	(0.961)	(2.993)	(0.945)	(3.109)	(0.942)	(3.167)
D_1981	-1.547*	5.552**	-1.533*	7.009**	-1.545**	6.348**
	(0.870)	(2.246)	(0.841)	(2.782)	(0.779)	(2.783)

D_1982	-3.413**	9.814***	-3.431**	11.45***	-3.345**	10.97***
	(1.461)	(3.224)	(1.452)	(3.904)	(1.449)	(4.026)
D_1983	-2.048*	11.59***	-2.042*	11.77**	-1.849*	10.49**
	(1.133)	(4.270)	(1.206)	(4.643)	(1.060)	(4.725)
D_1984	-1.462	10.03***	-1.445	7.854**	-1.211	5.65
	(1.181)	(3.072)	(1.093)	(3.921)	(1.156)	(4.361)
D_1985	-1.375	13.10***	-1.275	11.15**	-1.035	9.005
	(1.248)	(4.399)	(1.222)	(5.317)	(1.179)	(5.714)
D_1986	1.948	20.50***	1.801	21.52**	2.086	19.50**
	(1.196)	(5.437)	(1.311)	(8.893)	(1.344)	(8.814)
D_1987	0.758	13.84**	0.739	13.72*	0.808	11.82*
	(0.746)	(5.456)	(0.756)	(7.175)	(0.674)	(7.069)
D_1988	0.548	-3.506	0.703	-9.079*	1.106	-9.584**
	(1.392)	(4.763)	(1.375)	(5.147)	(1.246)	(4.181)
D_1989	-0.615	8.351**	-0.602	6.195	-0.324	4.751
	(1.174)	(3.529)	(1.333)	(5.829)	(1.170)	(4.941)
D_1990	-1.079	9.363**	-0.737	1.683	-0.768	-0.52
	(1.159)	(3.983)	(1.081)	(5.333)	(0.985)	(5.152)
D_1991	-1.044	8.292***	-0.837	4.244	-0.593	3.01
	(0.770)	(2.595)	(0.835)	(2.920)	(0.862)	(3.312)
D_1992	0.0569	6.675***	-0.0922	6.266*	0.355	3.834
	(0.878)	(2.387)	(0.919)	(3.341)	(0.953)	(3.527)
D_1993	-0.172	9.023***	-0.145	7.884	0.0928	5.819
	(0.634)	(3.031)	(0.638)	(6.088)	(0.710)	(5.802)
D_1994	0.741	6.502**	0.858	3.653	1.02	2.583
	(0.818)	(3.094)	(0.825)	(3.699)	(0.711)	(3.293)
D_1995	-0.898	5.548**	-0.828	3.687**	-0.679	2.735*
	(1.333)	(2.714)	(1.333)	(1.570)	(1.210)	(1.531)
D_1996	0.257	4.867	0.331	0.434	0.521	-0.575
	(0.679)	(3.088)	(0.617)	(2.012)	(0.521)	(2.650)
D_1997	-0.0904	6.158***	-0.148	5.856***	-0.0041	5.364**
	(0.757)	(2.154)	(0.760)	(2.260)	(0.758)	(2.533)
D_1998	-2.636**	10.85***	-2.708**	10.89***	-2.489*	10.39***
	(1.336)	(2.087)	(1.308)	(2.424)	(1.279)	(2.645)
D_1999	-1.661*	7.931***	-1.651**	6.946**	-1.483**	5.928*

	(0.882)	(2.232)	(0.837)	(2.883)	(0.749)	(3.212)
D_2000	-0.535	8.998***	-0.464	5.865***	-0.204	3.776**
	(0.752)	(3.070)	(0.667)	(1.918)	(0.557)	(1.919)
D_2001	-2.011*	12.32***	-1.999*	9.982***	-1.739	8.397***
	(1.197)	(2.958)	(1.176)	(2.951)	(1.061)	(2.452)
D_2002	-0.969	12.89**	-1.153	14.40*	-0.843	12.92*
	(1.266)	(5.472)	(1.354)	(7.472)	(1.211)	(6.926)
D_2003	0.589	8.356***	0.47	7.524**	0.565	5.864*
	(0.973)	(2.632)	(0.957)	(3.767)	(0.929)	(3.561)
D_2004	1.833*	8.321***	1.854*	6.080***	2.264**	6.397**
	(1.050)	(1.769)	(1.034)	(2.328)	(1.046)	(2.655)
D_2005	1.368*	4.773*	1.453*	-1.21	1.746**	-2.237
	(0.788)	(2.715)	(0.824)	(4.255)	(0.887)	(4.664)
D_2006	2.065*	6.088**	2.081*	1.296	2.218**	-0.208
	(1.063)	(2.898)	(1.076)	(1.956)	(1.045)	(2.266)
D_2007	0.201	9.578***	0.275	3.392*	0.558	2.486
	(0.677)	(2.693)	(0.618)	(1.781)	(0.517)	(1.935)
D_2008	-1.218*	7.900***	-1.219*	3.219	-1.028*	2.934
	(0.664)	(2.209)	(0.623)	(2.463)	(0.543)	(2.179)
Constant	-1.148**	10.75***	-1.139**	0.899	-0.712	0.771
	(0.577)	(2.156)	(0.550)	(1.380)	(0.559)	(1.564)
Observations	518	518	518	518	518	518
R-Squared	0.4808	0.8803	0.5163	0.8539	0.5169	0.8563
Number of COUN	14	14	14	14	14	14

Robust standard errors in parentheses, *Significance at 10%, **Significance at 5%, ***Significance at 1%
All coefficients are in percentage terms.
Y_{it-j}= The log of per capita GDP of country *i* at time *t - j* (in real value, 1990 Geary-Khamis Dollars)
D_{it-j} = Total (domestic plus external) gross central government debt-to-GDP ratio of country *i* at time *t - j*
***D60* = A dummy variable that takes value 1 if D_{it} > 60% and 0 otherwise.**
***D90* = A dummy variable that takes value 1 if D_{it} > 90% and 0 otherwise.**
$D(x)_{it-j} * Y_{it-j}$ Interaction term of the variables $D60_{it-j}$ or $D90_{it-j}$ and Y_{it-j}
$D(x)_{it-j} * D_{it-j}$ Interaction term of the variables $D60_{it-j}$ or $D90_{it-j}$ and D_{it-j}
***POL* = Political status of the country. It is a score ranging from 0 to 10 depending on the soundness of the democracy within the country.**
D_i= Country *i*- specific dummy variable where *i*=Argentina, Bolivia, Brazil, Chile, Columbia, Egypt, India, Indonesia, Malaysia, Mexico ,Philippines, Thailand, Uruguay
D_t= *The year t*- specific effect, where *t* = 1956, 1957, … , 2008

국문초록

공공부채 한계수준의 효과분석 : 패널 벡터자기회귀모형 접근

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조용신

본 연구는 Reinhart and Rogoff (2010)의 연구결과가 주장한 공공부채의 비선형성의 존재여부를 엄밀한 계량경제학적 도구를 이용한 보다 심도있는 연구를 통해 증명하고자 한다. 이를 위하여 선진국 20개 국가, 개발도상국 14개 국가의 GDP 대비 공공부채 비율, 그리고 각 국가의 1인당 실질GDP 성장률의 자료를 이용하여 패널 벡터자기회귀모형 (Panel Vector Auto-Regression Model)의 분석을 진행한다. 이 연구를 통해 다음 세 가지의 함의를 도출한다. i)공공부채와 1인당 실질GDP 성장률 사이에는 Granger Causality Test가 증명하듯 공공부채가 1인당 실질GDP에 영향을 미치는 일방적인 인과관계가 존재하며 그 반대의 인과관계는 성립하지 않는다; ii)선진국의 공공부채 한계수준(비선형성)은 동시적으로 (Contemporaneously) GDP대비 60% 수준에서 존재하며 개발도상국의 한계수준(비선형성)은 GDP대비 90% 수준에서 존재한다; iii) 선진국의 기간간 동태성은 GDP대비 공공부채의 수준이 60%를 넘어설 경우 그 추가영향은 파국적 (공공부채 증가, 실질성장률 하락) 방향으로 발산 (즉, Keynesian Effect가 거의 모두 상쇄됨)하며 개발도상국의 경우 GDP대비 공공부채의 수준이 90%를 넘어섬에도 그 추가영향이 미미하여 정부의 확장적 재정정책이 경기부양으로 이어지는 Keynesian Effect가 지속된다.

학번 : 2011 - 20195

주요어 : 공공부채, 패널 벡터자기회귀모형; Threshold Regression; Keynesian Effect; 리카르도 대등정리; Austerity